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# Science & Technology China

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## China's Aeroengine Industry Makes Steady Progress

40080030 Beijing GUOJI HANGKONG  
[INTERNATIONAL AVIATION] in Chinese  
No 10, 5 Oct 87 pp 8-9

[Article by Hang Yan [2635 1484]]

[Text] China's aeroengine industry was established shortly after the founding of the People's Republic. Its objectives are to provide the required power plants for military and civilian aircraft, and to engage in the research, design and manufacturing of mechanical and electrical products in order to satisfy the needs of national defense and economic developments. Its products are also exported to other countries. The aeroengine industry has become a production unit with strong capabilities in research, development and production and has developed technical expertise in various disciplines. It is now an important segment of China's aviation industry.

### I. Current Status and Technical Capabilities

During the initial phase of its development, China's aeroengine industry's capability was limited to repairing engines of simple design; then it developed the capability of producing piston-type engines. By the end of the 50's, China had mastered jet engine technology and become one of the few countries capable of mass-producing jet airplanes. After more than 30 years of development, it has become a mature industry with more than 100,000 workers, approximately 15 percent of them are engineering and technical personnel. The industry has 1.72 million square meters of production area, more than 18,000 units of machinery, and complete sets of engine test equipment. Much of this equipment is imported from the United States, England, France, West Germany and Switzerland.

In an effort to promote engine research and development, a number of aeroengine design and research organizations, material and manufacturing research institutes, and flight test research institutes were established in the mid 50's. The engine design and research institutes were involved not only in the design and research of aeroengines, but also in the applied research of aerodynamics, combustion, structural strength, materials, manufacturing processes, flight mechanics, computer technology, and engine regulation and control techniques. Also, various air supply equipment and test beds had been installed to support engine research and design, computer testing, the study of engine performance and strength, high-altitude simulation, as well as material testing and manufacturing processes. In addition, tests of various types of ground-based gas turbines were also conducted.

In the area of manufacturing, the aeroengine industry uses unique processes such as the sophisticated low-temperature and high-temperature techniques. It has the

capability to produce non-residue precision parts, monoergic and eutectic high-temperature turbine blades; it has also mastered such new techniques as precision forging, electronic welding, vacuum welding and heat-treatment, lasers, multi-element percolation, forced grinding, high-speed broaching, and hydro-static pressing and rolling. It has well-equipped physical and chemical test facilities capable of metallic and non-metallic chemical microscopic analysis, and non-destructive inspections using X-rays, fluorescent light, ultrasonic waves and lasers. It also has test facilities to perform mechanical tests and endurance/fatigue tests at room temperature and high temperature. In terms of metric standard transfer systems, there are various linear, thermal, optical, electric, magnetic and mechanic metric standard instruments; there are also complete metric verification systems to ensure that all the inspection tools, instruments and gauges meet design specifications. In short, the aeroengine industry is quite advanced technically.

### II. Accomplishments in Research and Production

Over the years, the aeroengine industry has developed seven different types of piston engines including eight different models, and eight different types of jet engines with 20 different models. It has built six engine series including the WP-6, the WP-7, the WP-13, the WJ-6, and the Turboshift-8 engines; they were designed to satisfy powerplant requirements for China's aircraft development and modernization.

#### 1. Development of the Turbofan-6 Engine

The Shenyang Aeroengine Design Institute has developed China's first high-thrust (122 KN), twin-rotor, turbofan engine with afterburner. After 20 years of research and development, during which time 114 challenging technical issues were resolved, the engine had successfully passed three continuous 24-hour pre-flight tests based on the test specifications for British military aircraft engines, and its performance had reached or exceeded design specifications. Also during this period, a team of highly-trained engine specialists had been established.

#### 2. Successful Full-Power Test of the Turboprop-9 Engine

In 1983, the Zhuzhou Aeroengine Design Institute took on the task of developing the VJ-9 engine. After three years of research and development, the first prototype was produced and a successful full-power (680 hp) test was successfully conducted on 27 December 1986 at an engine speed of 50,000 rpm. The test results showed that its technical performance met the design specifications. The successful development of the VJ-9 engine will provide a power plant for China's small passenger planes such as the Y-12 and agricultural aircraft.

### 3. Accomplishments in Research and Development of High-Performance Propulsion Systems

The research and development of high-performance propulsion systems was a long-term engineering project of the Ministry of Aviation Industry where the principle of system engineering was first applied; it involved a wide range of different topics and a large number of different organizations. The accomplishments of this project not only contributed to the improvement of China's existing aeroengines, but also laid a foundation for developing China's high-performance military aircraft engines. For example, the flame stabilizer developed by graduate student Gao Ge of the Beijing Aeronautical Institute was a major breakthrough in China's jet engine technology. Test results show that the performance of this type of flame stabilizer is superior than those used in other jet engines. This achievement received the first national invention award.

#### Engine Production for Domestic Aircraft

Since the establishment of the aeroengine industry, more than 50,000 engines have been produced, and the total number of accumulated man-hours has exceeded 7 million. These engines have been used in military aircraft, civilian airplanes, trainers, remotely-piloted airplanes, seaplanes, and helicopters; these engines also include ground-based gas turbines. They have played an important role in equipping the Chinese Navy and Air Force and in supporting China's allies.

#### Developing of Derived Industrial Gas Turbines

At present, five different types and 13 different models of industrial gas turbines have been developed. Specifically, 52 sets and 83 units of gas turbines including experimental and prototype engines have been produced. A total of 190,000 hours of operation had been accumulated and the longest period of operation without interruption was 13,400 hours. These units were primarily used for oil field power generation, heat supply, water injection, powering gas pumps, extinguishing fires in coal mines, and for air-cushion boats and experimental railroad cars.

The gas turbines already in production include: the WZ-6G (750 kW class) gas turbine built by the Jiangxi Lohe Machine Factory, which is used to power the water injection pump in the Zhongyuan oil field; the WZ-5G (1250 kW class) gas turbine developed jointly by the Harbin Engine Factory and the Wuxi No 2 Mechanical Research Institute which is used for power generation and water injection in oil fields and for driving natural-gas compressors; the DQ-1000 inert gas generator developed jointly by the Zhuzhou Aeroengine Design Institute and the Ministry of Coal Industry, which has been certified for fire extinguishing use in coal mines; and the WJ-6G (2000 kW class) gas turbine built by the Nanfang Power Machine Co (3 different models, 24 sets, and 42 units have been produced), which is primarily used for

power generation in oil fields and in the Lhasa Power Plant. In addition, the Shenyang Li Ming Engine co has already in production four sets of WP-6G thermo-electric generators and two sets of water injection generators; the first thermo-electric generator unit has been in operation for more than 10,000 hours, and has produced more than 40 million kWh of electricity and more than 100,000 tons of steam.

Currently under development are: a 4500-hp class heavy-oil type gas turbine used to power locomotives, a 6000-hp class industrial gas turbine and a 13000-15000-hp gas turbine for industrial and ship use.

#### Development of Commercial Products

To satisfy the needs of national economic development and commercial needs, the aeroengine industry has developed a number of mechanical products which include model airplane engines, automotive engines, motorcycle and other engines, aluminum products, air-driven textile machines, and liquid sand blasting machines. Many of these products are favorably received around the country for their quality, reliability and esthetic values. In 1986, the aeroengine industry produced 28 percent of the total amount of commercial products of the aviation industry.

#### Expanding Exports and Promoting International Cooperation

In the area of aircraft engines, China has established various agreements of international cooperation with more than 10 different countries that include technology transfer, processing of drawings, materials and samples, cooperation in production and design, and exchange of visitors. It had signed a contract with the Turbomeca Co of France to build the Arriel 1C engine; it had imported the manufacturing technologies of ground-based gas turbines from the Rolls-Royce Co of England; it had also signed a contract with Pratt and Whitney of the United States to jointly design, produce, develop and market the FT8 ground-based gas turbine. Today, most large engine companies in the world have products from China's aeroengine industry. In the area of commercial products, it had signed technical contracts with Japan to build motorcycle engines and engines for subcompact cars.

#### III. Future Prospects

In conjunction with meeting its obligation to perform research and development, to produce and to improve products for the military, the aeroengine industry will also devote its efforts in the future to accelerate the development of commercial products, to expand foreign trade, and to promote high-technology products in order to raise the standard of the national economy.

The main goal of the aeroengine industry for the Seventh 5-Year Plan is to understand and clarify the relationships between military and commercial products, between airplanes and engines, between adopting foreign

design and using China's own design, between preliminary research and prototype development, and between importing foreign technology and self reliance, to establish five central facilities (large and small engine research centers, engine test center, aerodynamic control and regulation center, and center for developing light-weight gas turbines), and to accomplish the following transforms: from imitating others to designing our own, from pure military production to joint military-commercial operation, and from closed-door development to international cooperation.

In the area of engines for commercial use, the goal for the Seventh 5-Year Plan is to modify three existing engines and develop two new engines in order to provide the required power plants for short-range passenger planes. In addition, cooperative efforts with other countries will be explored to study the feasibility of developing ductless fan engines.

In the area of industrial gas turbines, the main emphasis will be to serve the petroleum, chemical, coal ship and railroad industries; efforts will also be devoted to improving the existing engines and completing the current engine development task for the petroleum industry.

In the area of commercial production during the Seventh 5-Year Plan, the aeroengine industry's goal is to carry out technology reform, to establish a joint military/commercial production system, and to build 12 different development centers. The overall productivity during this period is expected to be four times the output of the Sixth 5-Year Plan; by 1990, the productivity of the aeroengine industry is expected to exceed 80 percent of the total output of the entire engine industry.

3012/9738

# **New Concept for Fusion Reactor Device**

40080021 Chongqing HEJUBIAN YU DENG LIZITI  
WULI [NUCLEAR FUSION AND PLASMA  
PHYSICS] in Chinese Vol 7 No 1, 1 Mar 87 pp 1-7

[Article by Cai Shidong [5591 6108 2639], Chen Yanping [7115 7159 5493], Guo Shichong [6753 0013 1404], Ke Fujiu [2688 1318 0036], Shen Jiewu [3088 6043 0124], Xu Minjian [1776 3046 0256], Yu Xuehua [0205 7185 5478], Zhou Yumei [0719 3768 5019], Wang Shijin [3076 6108 6855], and Zhang Chunyuan [1728 3196 3104] of the Plasma Research Society, Institute of Physics, Chinese Academy of Sciences, Beijing; and Chen Yunming [7115 0336 2494] of the Institute of Mechanics, Chinese Academy of Sciences: "A New Concept for a Fusion Reactor Device"; topic subsidized by the Science Fund of the Chinese Academy of Sciences]

[Text] Abstract: This article suggests a new concept for a fusion reactor device composed of two identical axisymmetric tandem magnetic mirror portions and two helical stellarator U-shaped curved segments. The device combines the merits of linear and toroidal configurations as well as fast and slow processes. The article studies the startup, transition, and operation phases. It discusses D-D reactor parameters and stability. RF and energetic components are required only during startup. There is only momentary energy consumption throughout the entire process, and the end plugs must be in place only during startup. This greatly simplifies engineering technical requirements.

Key words: Reactor concept, second stability region

## **I. Introduction**

Current development conditions indicate that Tokamaks, stellarators, axisymmetric tandem magnetic mirrors, and other quasi-stable devices have the greatest possibility of becoming the fusion reactor devices of the future. Tokamaks and stellarators have a toroidal geometric configuration and a relatively simple sealed magnetic surface. They are limited by bubble film instability and their  $g_b$  value is low (equal to or less than  $g_a/Rq^2$ , where  $g_a$  and  $R$  are the minor and major radii of the ring, and  $q$  is the safety factor). Tandem magnetic mirrors successfully proved the effectiveness of magnetic confinement with electrostatic terminal lugs. Such a device, however, requires that energetic components be sustained throughout the entire operation process, which consumes large amounts of energy. A new concept for a fusion device was suggested recently which attempts to find a way to avoid bubble film and kink instability in the toroidal device to facilitate operation in the high- $g_b$  second stability region.<sup>1-3</sup>

Based on experimental results from various existing devices, this article will integrate their advantages and propose a new fusion reactor concept.

## **II. A Brief Description of the Device**

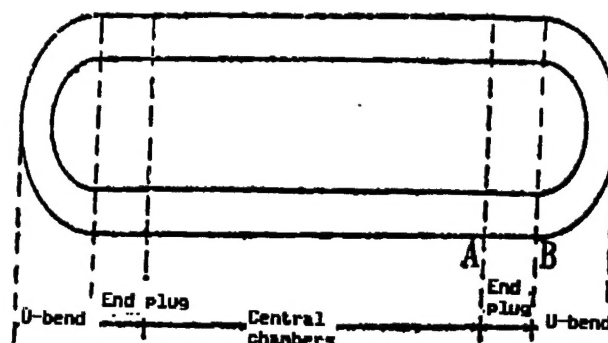


Figure 1. Oval Configuration

The reactor device we are proposing is composed of two identical axisymmetric tandem magnetic mirror portions and two rotary conversion  $g_i = 2$  U-shaped helical stellarators (referred to below as U-bends), as shown in Figure 1. This device combines the advantages of magnetic confinement and electrostatic confinement, and of magnetic mirrors and toroidal configurations. It employs both high energy particle and RF heating stabilization methods, and links fast and slow processes together. During startup, the plasma in the central chambers of the tandem magnetic mirrors is heated. Its  $g_b$  is recorded as  $g_{b_{cc}}$ . The end plugs in the tandem magnetic mirrors separate the rather high  $g_{b_{cc}}$  plasma in the central chambers from the moderate and low- $g_b$  (recorded as  $g_{b_{ub}}$ ) plasma in the U-bends. When  $g_{b_{cc}}$  is equal to or greater than 0.4, the auxiliary heating in the end lugs (neutral injection and RF heating) and the electric current in the magnetic mirror coils is removed quickly, causing the end plug potential to be eliminated during a relaxation period (of milliseconds). In this manner, the high- $g_{b_{cc}}$  plasma in the central chambers flows out at ultrasonic velocities while the low- $g_{b_{ub}}$  plasma in the U-bends is able to enter the second stability region quickly. During this process, MHD instability never increases to the extent that the confinement is destroyed. Afterwards, the reactor can serve as a high- $g_b$  oval stellarator at sustained operation. If a longitudinal current is permitted to exist, it is a high- $g_b$  Tokamak operating in the second stability region.

Because RF and energetic particle heating and stabilization are needed only during the startup phase (startup phase time  $g_t$  is equal to or less than 0.1s,  $g_t^{NB} g_t g_t^{ic}$ , where  $g_t^{NB}$  is the neutral injection slowing time and  $g_t^{ic}$  is the in-electron collision time), the demands placed on the end plugs and stabilization are much lower than tandem magnetic mirrors and EBT.

After precise calculations, we proposed that the end plug potential be placed at the point of minimum  $B$  on the end plugs, that Sloshing electrons<sup>4</sup> be used to create a thermal barrier, that ECRH and ICRF be used for plasma heating, and that the height of all potential barriers be increased. The neutral beam and ICRF added to the central chambers during startup make  $T_{ic} T_{ec}$



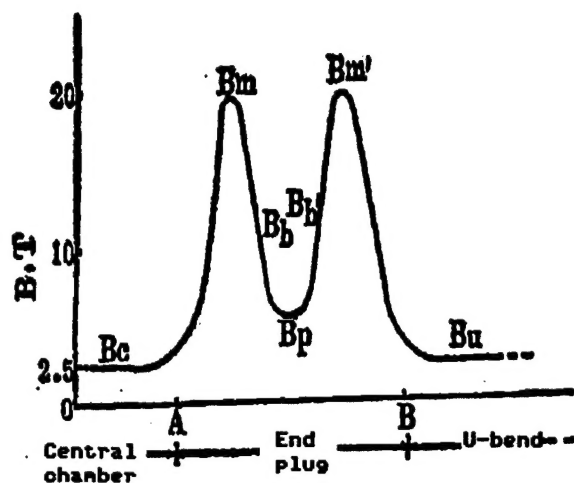


Figure 2. Axial Distribution of Magnetic Field During Startup of One-Fourth of the Device. Mirror ratio:  $R_{mc} = B_m/B_c = 8$ ,  $R_{mp} = B_m/B_p = 4$ ,  $R_{bp} = B_b/R_p = 2$ ,  $B_m' = B_m$ . A and B correspond to points A and B in Figure 1.

(because  $gt \approx gt_{ic}$  and  $T_{i1} \approx T_{i11}$  ( $gt$  is approximately less than  $gt_1 = gt_{i1}$ ). This greatly relaxes the demands on ion pumps and increases efficiency. The radial potential difference and thermal components also aid in reducing Pfirsch-Schluter currents.

### III. Structure and Dimensions

The device referred to can have an oval geometric configuration (Figure 1). It includes two linear solenoid central chamber portions, two  $g_i = 2$  helical U-bends, and four axisymmetric end plugs (inserted between the solenoids and the U-bends, and required only during startup). Figure 2 shows the axial distribution of the magnetic field  $B$  during startup of one-fourth of the device.

To attain a high  $Q$  value and a relatively small  $gb_{cc}/gb_{ub}$ , it is best if the volume of the central chambers is rather large. Here, we derive  $V_{cc}/(V_{ub} + V_p) = 3$  (where  $V_{cc}$ ,  $V_{ub}$ , and  $V_p$  are the volumes of the central chambers, the U-bends, and the end plugs, respectively). It also requires  $gb_{cc}$  is approximately equal to 0.5 and  $gb_{ub}$  is approximately equal to 0.01 at the end of the startup phase to assure that the plasma in the U-bends is in the first stability region and that the terminal plasma is in the second stability region. It is assumed that the U-bend

$$\begin{aligned} L_{total} &= 2[L_{cc} + L_{ub} + 2L_p] \\ &= 2[3(L_{ub} + 2L_p) + L_{ub} + 2L_p] \\ &\approx 8\left(\pi \frac{R}{a}\right)a + 16(0.6R_{mp})a. \end{aligned} \quad (1)$$

vertical/horizontal ratio  $R/ga = 4$ , the mirror ratios of the central chambers and the U-bends ( $R_{mc}$  and  $R_{mu}$ ) are 8, and the end plug mirror ratio  $R_{mp} = 4$ . Thus, the total length of the device is

It was assumed that  $L_{cc} = 3(L_{ub} + 2L_p)$ . The radius of the magnetic mirror  $ga$  should be determined by the penetration depth of the neutral beam. For example, when  $ga = 0.5$  m,  $L_{Total}$  approximately equals 70 mm. A reactor of these dimensions is extremely compact. Its magnetic field intensity is shown in Figure 2. The derived  $B_c = B_u = 2.5$  T,  $B_m = 20$  T,  $B_p = 5$  T, and  $B_b = 10$  T.

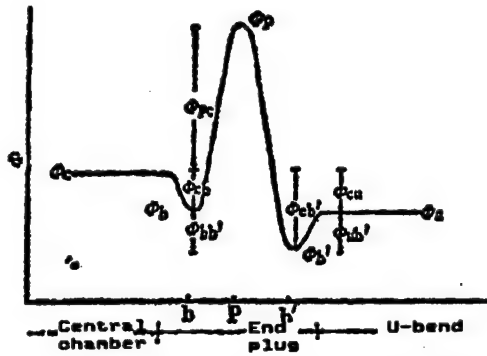
### IV. Startup Phase

#### 1. Calculations for configurations, heating, power equilibrium, and other parameters

When startup begins, a low- $gb$  plasma is obtained with parameters of  $n_{cc}^0 = n_{ic}^0 = 2 \times 10^{13} \text{ cm}^{-3}$ ,  $n_{eu}^0 = n_{iu}^0 = 10^{13} \text{ cm}^{-3}$  (Note 1: To assure that  $gb$  is approximately less than 0.01, we hope that  $n_u^0 \approx n_e^0$ . If the end plug potential is increased gradually from the start, this requirement can be met.), and  $T_e = T_i$  is approximately less than 5 keV. The thermonuclear plasma in the central chambers is obtained with the aid of neutral injection (the neutral beam particle energy is  $ge_i$  approximately equal to 70-100 keV) and ICRF. They increase  $gb_{cc}$  to about 0.5 within 0.1 second, which is  $n_{ic} = n_{ec}$  approximately equals  $1.4 \times 10^{14} \text{ cm}^{-3}$ ,  $T_{ic}$  approximately equals 50 keV, and  $T_{ec}$  approximately equals 5 keV. During the process of central chamber heating, the end plugs are used to separate the high- $gb_{cc}$  central chamber plasma from the low- $gb_{ub}$  U-bend plasma. At the site of minimum B in the end plugs (point P), the neutral beam with a vertical injection energy of  $ge_i$  approximately equals 300 keV creates an end plug positive potential barrier. ECRH is used to heat the electrons at site P on the end plugs to increase the positive barrier potential of the end plugs and to form sloshing electrons at sites b and b' to facilitate the formation of thermal barriers at sites b and b'. At the same time, ICRF can be added to the central chambers to increase the stability of the plasma<sup>5</sup> and reduce particle flow from the central chambers toward the end plugs.

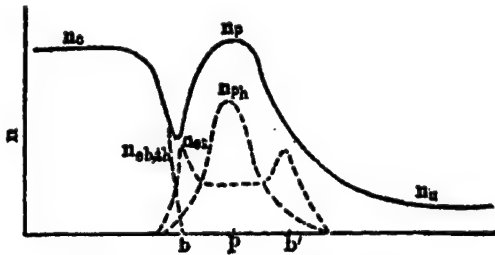
Below, the various physical parameters at the end of the startup phases are calculated self-consistently. The electrostatic potential and density distributions are shown in Figures 3 and 4.





$\phi_{cb}=15\text{keV}$ ,  $\phi_{pc}=150\text{keV}$ ,  $\phi_{ca}=11\text{keV}$ ,  $\phi_{bb'}$   
 $=7.4\text{keV}$ ,  $\phi_{bb''}=18.4\text{keV}$ ,  $\phi_{bb'''}=3.4\text{keV}$ .

Figure 3. Distribution of Electrostatic Potential



$n_c=1.4 \times 10^{14}\text{cm}^{-3}$ ,  $n_b=7.2 \times 10^{13}\text{cm}^{-3}$ ,  $n_{bb,th}$   
 $=7.0 \times 10^{13}\text{cm}^{-3}$ ,  $n_{ss}=8.5 \times 10^{13}\text{cm}^{-3}$ ,  $n_p=1.47$   
 $\times 10^{14}\text{cm}^{-3}$ ,  $n_{ps}=3.2 \times 10^{14}\text{cm}^{-3}$ ,  $n_{ph}=1.15 \times$   
 $10^{14}\text{cm}^{-3}$ ,  $n_{su}=1.55 \times 10^{13}\text{cm}^{-3}$ ,  $n_{bb',th}=3.5$   
 $\times 10^{13}\text{cm}^{-3}$ .

Figure 4. Axial Distribution of Density at Completion of Slow Model Operation Startup Phase Total density — Density of different types of electrons)

which makes a faster central chamber heating process very important. Because the period of equal ion-electron energies in the central chambers is greater than 0.1 second long, if the central chamber heating time is less

than 0.1 second, then  $T_{ic} T_{ec}$ , which would greatly reduce the actual  $n_{ib}$  value. For this reason, only low energies ( $g_{ci}$  is less than 50 keV) and relatively weak ion pumps are required to attain  $g = 1$ ,  $g_a$  is identical with  $n_b/n_{b,th} = 10.3$  and to form thermal barriers of the required height at sites b and b'. The thermoelectron density at site b is

The  $E_b$  in the formula is the minimum energy of the electrons captured in the thermal barrier, while  $E_{b'} = gF_b/(R_{cb}-1)$ .  $E_{se}$  is in keV units.

The other energy and power parameters calculated are listed in Table 1.

## 2. Stability

Like EBT and tandem magnetic mirrors, a bad curvature region also exists in this device. Several authors have made comprehensive theoretical<sup>10</sup> and experimental<sup>5,11</sup> studies of stability. We predict that the thermal components in the end plug region and an appropriately chosen ICRF<sup>5</sup> would provide the required stability for the plasma during startup. Theoretical research by Berk,<sup>12</sup> Rosenbluth,<sup>3</sup> and others concerning the stability of energetic particles in EBT, tandem magnetic mirrors, and Tokamaks, and the results of recent experiments with EBT,<sup>13</sup> Phaerdrus, and HIEI<sup>5</sup> devices are extremely encouraging.

If the energy of the Sloshing electrons in the end plug region is 3 MeV, the  $g_{bp}$  value would lie within the Van Dam-Lee limits,<sup>14</sup> and the discoidal distribution of the thermoelectrons also would make the pressure gradient-driven thermoelectron model stable.<sup>12,15</sup> If the axial extension of the Sloshing electrons is greater than  $L_p/2$  (that is,  $B_b = B_{b'}$  10T), the weight of the Sloshing electrons would be much greater in the good curvature region, which can stabilize the grooved model of the bad curvature region.<sup>16</sup>

Moreover, an appropriate amount of ICRF can be applied in the central chambers or the U-bends to provide RF stability.<sup>5</sup>

By setting  $\phi_{ob}=3T_{ec}=15\text{keV}$  (see Figure 3), the transitting ion density<sup>6</sup> at site b can be derived (all densities in this article are given in units of  $\text{cm}^{-3}$ ),

$$n_{ib,pass} = \frac{n_c}{R_{mb}} \left( \frac{T_{ic}}{\pi \phi_{ob}} \right)^{1/2} = 7.2 \times 10^{13}, \quad (2)$$

The total ion density at site b during equilibrium is

$$n_{ib} = n_c \exp(\phi_{ob}/T_{ic}) = 1.89 \times 10^{14}, \quad (3)$$

This implies

$$g \equiv n_{ib}/n_{ib,pass} = 2.6. \quad (4)$$

$$n_{ob,th} = n_o \exp(-\Phi_{ob}/T_{eo}) = 7.0 \times 10^{12}. \quad (5)$$

This requires a Sloshing electron density at the site (produced by an appropriately-designed ECRH) of

$$n_{os} = (\alpha - 1)n_{ob,th} = 6.5 \times 10^{13}, \quad (6)$$

From neutralized conditions

$$n_{ou} \exp(-\Phi_{ub'}/T_{ou}) + n_{os} = n_{iu} \exp(\Phi_{ub'}/T_{iu}), \quad (7)$$

to derive

$$\Phi_{ub'} = 7.45, \quad (8)$$

in keV units assuming  $n_{iu} = n_{ou} = 1.55 \times 10^{13} \text{ cm}^{-3}$ ,  $T_{iu} = T_{ou} = 5 \text{ keV}$ , from this

$$n_{ob',th} = n_o \exp(-\Phi_{ub'}/T_{eo}) = 3.5 \times 10^{12}, \quad (9)$$

Therefore,

$$\alpha' \equiv n_{ob'}/n_{ob,th} = 19.6. \quad (10)$$

At location P, the derived and plug potential is

$$\Phi_{pb} = 3T_{io} + 3T_{eo} = 165, \quad (11)$$

in keV units, and the thermoelectron temperature is

$$T_{ep} = 150, \quad (12)$$

in keV units. They determine the thermoelectron density at the site of the end plugs

$$n_{ph} = n_o \left( \frac{T_{ep}}{T_{eo}} \right)^{1/2} \exp \left( \frac{\Phi_{pb}}{T_{ep}} - \frac{\Phi_{ob}}{T_{eo}} \right) = 1.15 \times 10^{14}. \quad (13)$$

Sloshing electrons also contribute to the total electron density at the site of the end plugs. The Sloshing electron density at the site of the end plugs can be derived from particle flux conservation

$$n_{ps} \approx n_{os}/R_{bp} \approx 3.2 \times 10^{13}. \quad (14)$$

Thus, the total electron density at site P is

$$n_p = n_{ph} + n_{ps} = 1.47 \times 10^{14} \approx n_o. \quad (15)$$

The difference in potential between the central chambers and the U-bends can be calculated using the method proposed by Catto, et al.

$$\frac{\Phi_{ob'}}{T_{eo}} = \frac{\Phi_{ub'}}{T_{ou}} - \ln \left[ \frac{n_u}{n_o} \left( \frac{T_{eo}}{T_{ou}} \right)^{1/2} \right] = 3.69, \quad (16)$$

By combining formulas (8) and (16), we derive

$$\Phi_{ou} \approx 11, \quad (17)$$

in keV units. The total electrostatic potential for the entire reactor should be approximately zero, i.e.,

$$\frac{1}{3}(150 - 15 - 18.4) \times 2L_p - 11L_{ub} + L_o\Phi_o \approx 0. \quad (18)$$

Of this, it is assumed that the end plug potential and two thermal barriers each occupy one-third of the end plug chambers. From this,

$$\Phi_o \approx -\frac{L_{ub}}{L_o} \left( \frac{2L_p}{L_{ub}} \times 38.9 - 11 \right) \approx 1. \quad (19)$$

with  $\Phi_o$  expressed in keV units. For this reason, the device can be called an "equilibrium model."

The energy of the Sloshing electrons can be calculated using the following formula:

$$E_{se} = \frac{T_{eo}(\alpha - 1)}{\exp(-E_b'/T_{eo}) \log_{10} R_{mb}} = 3 \times 10^3, \quad (20)$$

Parameter		Power, MW	Power per unit area kW/cm <sup>2</sup>
End plugs	ECRH (obtained $T_{ep}=150\text{keV}$ )	5.4	0.68 (surface area $2\pi r_p^2$ )
	Power obtained from sloshing electrons	4.4	
	Lost power provided to electrons transitting the central chamber	9.6	
	Lost power provided to electrons transitting the U-bends	4.8	
	Neutral beam injection ( $E_i=300\text{keV}$ )	48	
Central chamber	Neutral beam injection ( $E_i=70\text{keV}$ )	254	3 (surface area $0.2\pi r_c L_c$ )
	ICRF (for stabilization and preventing ions from entering the loss cone)	Much less than neutral beam injection	
Thermal barrier	ECRH (producing sloshing electrons)	34	8.6 (surface area $2\pi r_b^2$ )
	Recycled radiation	41	
	Power exchanged between sloshing electrons	4.4	
	Neutral beam pumps		
	( $\theta_{in} < 45^\circ$ )		
	$E_i=20\text{keV}$	0.77	
	$\frac{\langle \sigma v \rangle_{ex}}{\langle \sigma v \rangle_{ion}} \approx 3$ (D atoms)		
	$E_i=50\text{keV}$	3.0	
	$\frac{\langle \sigma v \rangle_{ex}}{\langle \sigma v \rangle_{ion}} \approx 1$ (D atoms)		

## V. Fast Transition

### 1. Interruption of electrostatic potential barriers and magnetic potential barriers

If  $gb_{cc}$  is similar to 0.5, we can interrupt the current in the magnetic mirror coil, the neutral injection, and ECRF to facilitate removal of the magnetic field in the magnetic mirrors and the electric potentials and thermal barriers of the end plugs. A carefully designed return circuit and selection of appropriate components would enable removal of the magnetic field in the magnetic mirrors within milliseconds, and there would be only a very small magnetic field oscillation in a vertical direction. The technical conditions for rapid removal of a magnetic field already exist, an explosion being one of them. By adopting a unidimensional model and assuming an adiabatic process and flux conservation, the results of numerical calculations indicate that when the time of magnetic field removal is greater than 3 gms, the magnetic field in the end plugs will be reduced without oscillation to the magnetic field value in the central chambers.

### 2. Parallel shock wave heating

Because the end plug energy can be removed rapidly within milliseconds, one can envisage that this would induce a parallel shock wave to sweep through the

U-bends. This would heat the plasma in the U-bends when MHD instability does not have sufficient time to destroy the confinement. The pressure discontinuity created after removal of the end plugs is similar to  $34\text{N/cm}^2$  (assuming  $gb_{cc}$  is similar to 0.5) and the shock wave velocity would be similar to  $1.4 \times 10^8\text{cm/s}$ . If an MHD shock wave model is used, the maximum instantaneous local  $gb$  value could reach 0.63. The predicted final  $gb$  value could be similar to 0.48. Because thermoelectron velocities are much faster relative to the velocities of the ions and electron fluid, no sort of dual-current instability could be induced.

## VI. The Operation Phase—A High- $gb$ Stellarator

After the end of the fast transition period, a high- $gb$  plasma identical to the terminal plasma proposed by Furth and Boozer<sup>2</sup> is attained in the oval stellarator configuration. If we permit the existence of a longitudinal current, it would be a high- $gb$  Tokamak plasma similar to that proposed by Rosenbluth, et al.<sup>3</sup> This would be sustained operation of the plasma in the second stability region.

## VII. Discussion

We have proposed a new concept for a fusion reactor based on existing experimental results and theoretical work. We also proposed that the advantages of magnetic

confinement and electrostatic confinement, and of circular and magnetic mirror configurations be integrated to attain stellarator or Tokamak high-gb plasma in the second stability region using both quasi-static and fast process patterns. RF and energetic particle stability as well as the end plugs would be required only during the startup phase. The startup time  $t_s$  would be much longer than the neutral beam slowing time and much shorter than the period of equal electron-ion energies. Thus,  $T_{ic}$ ,  $T_{ec}$ , which could cause a much smaller value of  $g$  (because  $gF_{cb} T_{ic}$ ). As a result, only low energy ( $E_i$  is approximately less than 50 keV) and relatively weak ion pumps would be required. There would be no need for the low efficiency ( $\epsilon_{ex/ion} \approx 1$ ) energetic ion pumps used in tandem magnetic mirror reactors. Because the rotary transformation  $g_i = 2$ , this would eliminate the gDB charge separation caused by the ring effects in the U-bends. A short startup phase would conserve large amounts of heating energy to attain a rather high rector  $Q$  value, and greatly reduce the requirement and engineering difficulty of the end plugs. The superconducting high magnetic field magnetic mirror coils would no longer be needed and technologies for rapid removal of magnetic fields also are mature. Plasma stability could be assured by relying on the rather long periods during which the ICRF, energetic particles, and sloshing electrons remain in the good curvature region. If necessary, an 8-pole field could be added between each of the central chambers and end plugs. The longitudinal shock wave heating energy would raise  $g_{ub}$  to the second stability region within a few milliseconds and without inducing instability. The RF and neutral beam power required could be obtained with existing technologies.

If the plasma in the central chambers could be heated within a few one-hundredths of a second, the ion pumps can be eliminated. More power would be needed for neutral beam injection in the central chambers, however, and the total densities of the flux electrons and thermal barrier sites arriving from the central chambers at this time would be reduced. This would reduce the average energy and recycled radiation losses of the thermal barrier electrons.

All of the potential, density, temperature, and power balances used in this article derived self-consistently. Additional calculations and experiments are needed to complete this encouraging new reactor concept. This is especially true of careful study of high-gb ring equilibrium, stability, and transport, which will be done in future work.

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12539/9365

## Scanning Electron Microscopy of Laser-Induced Retinal Damage

40081018a Beijing ZHONGHUA YANKE ZAZHI [CHINESE JOURNAL OF OPHTHALMOLOGY] in Chinese Vol 23 No 3, May 87 pp 129-130

[Article by Xu Jiemin [1776 4309 2404], Zhou Shuying [0719 3219 5391] and Cao Weijun [2580 4850 6746] of Beijing Institute of Radiation Medicine]

[Summary] Scanning microscopy of normal rabbit retina and rabbit retina subjected to CW Nd:YAG, multifrequency Nd:YAG, and ruby laser irradiation are compared. The laser damage lies mainly in the outer segment

and pigment epithelium of the retina, such as denudation of microvilli, debris of visual receptors, ragged holes and crater-like lesions. The diverse morphologic changes in relation to wavelength and exposure dosage are discussed.

Eight pictures show normal outer segment, pigment epithelium and granules of normal rabbit retina; leaf-like and vegetable-flower-like lesions in visual cell layer; laser-damaged holes on pigment epithelium; crater-like lesions on the retina, and hemorrhagic lesions underneath; and denudation of microvilli in the pigment epithelium. The authors are grateful to the Equipment and Measurement Section of the authors' laboratory for providing laser equipment and assisting in determining exposure damages.

10424/12913

**Establishment of Hybridoma Cell Lines Secreting Monoclonal Antibodies Against Enterovirus 70**

40081018 Beijing ZHONGHUA YANKE ZAZHI  
[CHINESE JOURNAL OF OPHTHALMOLOGY] in  
Chinese Vol 23 No 3, May 87 pp 131-132

[Article by Mu Guifan [3092 2710 5672], Wang You'an [5369 1635 1344] and Gu Fangzhou [7357 2455 5297] of the Institute of Basic Medicine, Chinese Academy of Medical Sciences; Immunology Research and Training Cooperation Center, World Health Organization (WHO); and Department of Basic Medicine, Xie'ho (Hope) Medical University, China]

[Summary] Two cell fusions were carried out with SP 2/0 cells and spleen cells from BALB/C mice immunized with enterovirus 70 prototype strain (J 670/71). The fusion percentage was 93 percent. A total of 67 positive clones were screened by indirect immunofluorescence and microneutralization tests. Of these, 30 were cloned by limited dilution, from which 13 hybridoma cell lines were obtained which persistently secreted monoclonal antibodies to E 70: antibodies from 8 cell lines were positive both in indirect immunofluorescence and neutralization tests, 3 cell lines were positive in indirect immunofluorescence only, and 2 cell lines possessed virus neutralizing activity but were negative in indirect immunofluorescence. One table shows the results of monoclonal antibody determination.

There are three citations with Chinese authorship: (1) Gu Fangzhou et al., "Establishment of Hybridoma Cell Line (E55) Secreting Monoclonal Antibodies Against Type I Poliomyelitis," ZHONGHUA WEISHENGWU-XUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY], 1982, 2:138; (2) Shi Ousheng [2457 5096 4563] et al., "Isolation and Determination of Epidemic conjunctivitis Virus in 1971," WEISHENGWU XUEBAO [JOURNAL OF MICROBIOLOGY], 1974, (1):17; and (3) Shen

Meijun [3088 5019 0689] et al., "Isolation and Determination of Acute Hemorrhagic Conjunctivitis Virus in Shanghai Municipality," ZHONGHUA YANKE ZAZHI, 1979, 15:90.

10424/12913

**Visual Acuity Determined by Laser Interference Fringes**

40081018d Beijing ZHONGHUA YANKE ZAZHI  
[CHINESE JOURNAL OF OPHTHALMOLOGY] in  
Chinese Vol 23 No 3, May 87 pp 151-154

[Article by Wang Fangrun [3076 5364 3387], Shen Huamin [3088 5478 2404], Yuan Peiming [7086 1014 2494] and Yu Huiming [0205 1979 2494] of the Ophthalmology Ward, Jinshan Hospital, Shanghai Medical University]

[Summary] Introduction of the concepts of spatial frequency and modulation transfer function (MTF) into ophthalmology resulted in major advances in the research on human vision in the retina-brain system. In the paper, the interference fringe-based visual acuities (IVA) of normal subjects and patients with eye diseases (totalling 447 cases) were determined with a YC-4020 model laser retinal modulation transfer function apparatus with useful findings. Operation and applications of this instrument were discussed. This method can rationally indicate visual function as a desirable quantitative observation index in the ophthalmological clinical and research efforts. One figure shows Young's interference on retina. Three tables show decimal and five-scale-division IVA and SF (spatial frequency) records, vision statistics under conditions of varied light refraction, and vision determination for amblyopic eyes. There are three citations with Chinese authorship: (1) Jin Chengpeng [6855 2052 7720] et al., "Determination of Retinal Functions With Laser Interference Method," ZHONGGUO SHENGWU YIXUE GONGCHENG XUEBAO [CHINESE JOURNAL OF BIOMEDICINE ENGINEERING], 1984, 3:156; (2) Wang Fangrun et al., "Determination of Comparative Acuity Functions of Human Eyes," WENZHOU YIXUEYUAN XUEBAO [BULLETIN OF WENZHOU MEDICAL COLLEGE], 1985, 15:12; and (3) Miao Tianrong [4924 1131 2837], "Logarithmic Vision Chart and Five-Scale-Division Recording Method," ZHONGHUA YANKE ZAZHI, 1966, 13:96.

10424/12913

**Chinese Information Processing and Xenix Kernel Expanding and Modifying**

40090050 Beijing JISUANJI YANJIU YU FAZHAN in  
Chinese Vol 24 No 8, Aug 87 p 49

[English abstract of article by Sun Yufang and Li Youzhi of the Institute of Software, Academia Sinica]

[Text] This paper analyses the basic functions and structures of the Xenix Kernel, and it is shown that the expansion and modification of the C-Xenix Kernel can

be performed. The tasks include: expansion of the kernel space, association of the character input/output routines with the Chinese dictionary, character library and these handling routines, delay handling, parity check and ambiguity processing for Chinese character internal codes, automatically swapping of the Chinese character dictionary and scheduling of the second level Chinese character library, etc. Finally, some viewpoints about the kernel modification are presented.

/06091

### Status of Liquid Crystal Studies in China Reviewed

40080008a Beijing WULI [PHYSICS] in Chinese  
Vol 16, No 8, Aug 87 pp 470, 456

[Article by Xie Yuzhang [6200 3022 4545], Department of Modern Applied Physics, Qinghua University: "The Recent Situation in Development of Liquid Crystal Science in China"]

[Text] On 20 December 1982 at the Third National Congress of the China Physics Society we reported on the situation in developments in liquid crystal science in China (see WULI No 12 (1983), p 287) and 4 years have passed since then. During this time there has been an upsurge of reform in all areas in China. Reform clearly has also spurred on the development of liquid crystal science in China. This paper will briefly introduce the development situation in various areas of liquid crystal science in China in recent years. It should be noted in particular that the author does not know the situation of liquid crystal work in Taiwan, thus that is not discussed in this paper.

### 1. Liquid Crystal Physics

Since the first group of liquid crystal graduate students obtained their master's degrees from the Institute of Physics of the Chinese Academy of Sciences and the Department of Modern Applied Physics of Qinghua University, every year there have constantly been new liquid crystal workers with master's degrees appear on the scene throughout China. In 1984 the Institute of Physics of the Chinese Academy of Sciences and the Department of Modern Applied Physics of Qinghua University each had one graduate student earn a doctorate. Their doctoral dissertations were entitled "Solitons in Liquid Crystal" and "Frequency Multiplication Effect Theory in Filament Liquid Crystals," respectively.

Since 1983, China's scholars have published dozens of articles related to liquid crystal physics in important specialized periodicals both in China and abroad. These articles have been devoted to theory and practice in almost even numbers. Definite results have been obtained in China in liquid crystal physics research on such topics as non-linear optics, chaotics, soliton, etc.

which are issues which are currently given serious consideration in physics circles. These results have been published in important specialized periodicals.

### 2. Liquid Crystal Chemistry

Various types of liquid crystal materials have been synthesized in China. Most of these materials have been test manufactured because they have practical value, for example, liquid crystal which has a wide temperature range, ferroelectric liquid crystal, liquid crystal which possesses high negative dielectric anisotropy, liquid crystal which is suited to color display, etc. Research has also been conducted on some physical characteristics of the liquid crystals which have been successfully developed. Work is currently under way on plate molecule liquid crystal and synthesizing work on bowl shaped molecular liquid crystal which has recently appeared which are both still in the realm of pure scholarship at present and results have been achieved. In addition, fengjiejiao [1409 2234 5231], which is used for liquid crystal display components has been synthesized and has already gone into small batch production. Components manufactured with this fengjiejiao have been subjected to more than 100 hours of high temperature, high humidity tests and still are intact.

Polymer liquid crystals is a branch which has come into being internationally in recent years. Domestic research on this aspect has also developed very rapidly. Currently, nearly 20 units have research topics in this area. Rather more research is on thermotropic aromatic polyester liquid crystals. And work is also under way on lyotropic aromatic polyester liquid crystals and polymer liquid crystal state spinning.

### 3. Biological Liquid Crystals

The number of people in China who are pursuing biological liquid crystal work are rather few. Some of the work which is now under way includes such topics as: using nuclear magnetic resonance spectrum to study the interaction of Bunolol and artificial membrane; the structure of crystalline matter in the development process of chick embryos; phase changes of vitellus in the development process of chick embryos; small-angle X-ray diffraction of the crystalline—liquid crystal structure of egg vitellus phospholipids; liquid crystal nature of bovine corneas; the liquid crystal nature of crystals; the phase change characteristics of lipid matter in vertebrate brain stem tissue; characteristics of the liquid crystal structure of the ultraviolet seeing protoplasmic membrane in pigs' eyes. It should be pointed out that China's workers on biological liquid crystals have discovered that the developmental process of chick embryos and some other physiological illness change processes display liquid crystal phase change phenomena. This discovery provided valuable information for biology and pathology.



#### 4. Liquid Crystal Applications

The primary liquid crystal application is still for producing kinked filament liquid crystal box digital display components. Production lines in China for this area have increased from the original two to five and there are three or four others being imported. The production lines already constructed have a certain productive ability, the quality of the products is rather high, and the products are primarily for the export market. There have also been certain results domestically in the development of multi-circuit driven pocket calculators. Various problems associated with color display are also problems which have interested liquid crystal workers. Liquid crystal light valves is still an object of research of some workers. Some products which have been successfully trial manufactured have won national or local prizes.

Quality of display components is of course related to product performance and at the same time is also related to product use. Quantitative data on display component performance will vary with the different methods used to trial manufacture it. Internationally there are still no generally accepted component performance standards. National measurement methods and standards for liquid crystal display component performance have been formulated in China to be able to carry out an objective comparison of the products of production units. These measurement methods and standards have been recommended to international standardization organizations. In addition, national standards have been formulated for the nomenclature of liquid crystal display component model numbers.

Some plants have recently begun to express an interest in thermochromatic liquid crystals. It seems that before long China may have a domestically manufactured liquid crystal thermometer. Work on using liquid crystal thermogram to diagnose early stage breast cancer is still continuing. Recently work has also been under way on using liquid crystal thermography to diagnose goiter and differentiate benign and malignant lung tumors. The most recent application of temperature measuring liquid crystal membranes has appeared in observing the circulation channels of hot and cold sensation and special reactions of China's traditional acupuncture. In this area it can be said to be a breakthrough in traditional Chinese medicine.

#### 5. Liquid Crystal Branch Science Society

Since the Liquid Crystal Branch Society of the Chinese Physics Society was founded on 18 July 1980, the number of members has nearly tripled. During this period two large-scale academic conferences and three special topic conferences were held and in addition, four study groups were held. These activities played a good promoting role in the growth of China's liquid crystal science. Recently, the Liquid Crystal Branch Society held its second meeting of the board of directors. At the

meeting such developments as local branch work, specialized branch work, and consulting work were discussed to be able better to have liquid crystal science society play a greater role.

Although China's liquid crystal science has established a mainstay rank in the past 10 or so years, whether in terms of numbers or quality, this rank is far from satisfying the needs of China's four modernizations. In particular, in the production area, how to achieve Chinese manufacture of the materials, how to improve the specialization level of technical personnel and be able to quickly use products for updating, still await the efforts of China's liquid crystal workers. In the generally good situation of domestic reforms, I hope that China's liquid crystal science can develop by leaps and bounds.

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#### Development of Fast Breeder Reactors in China 40080008b Beijing WULI [PHYSICS] in Chinese Vol 16 No 8, Aug 87 pp 487-493, 460

[Article by Li Shounan [2621 1108 2809], Chinese Academy of Atomic Energy: "Fusion-Fission Hybrid Reactors—The Path of China's Development of Breeder Reactors"]

[Excerpt] In 1980 in my report at the meeting to establish the China Nuclear Society I proposed as a nuclear energy development strategy for China that in the second stage of China's nuclear energy development whether we could abandon the fast reactor and take the path of fusion-fission hybrid reactor. It was well received by the Plasma Physics Institute of the Chinese Academy of Sciences. Subsequently, a small group to carry on study of a hybrid reactor was established and in 1985 proposed the HTHR physics concept design of China's first hybrid reactor<sup>[7]</sup>. In 1984 I systematically introduced the fusion-fission hybrid reactor at such locations as the Nuclear Industry Ministry's Fast Reactor Verification Meeting and the Southwest Physics Institute<sup>[8]</sup> and presented my proposal for dividing the development of fusion in China into the two stages of a hybrid reactor and a pure fusion reactor. It was unanimously supported by the leadership and science and technology personnel of the Southwest Physics Institute. In 1985 this institute completed a concept design of a rather complete magnetic mirror hybrid reactor (CHD)<sup>[9]</sup>. In December 1985 China's first Hybrid Reactor Symposium was convened at Leshan in Sichuan. At the meeting the strategic idea of a two-stage development of China's nuclear fusion was unanimously approved. Through efforts in a variety of areas, the fusion-fission hybrid reactor is now ranked with the fast reactor as a pre-research topic for China's Seventh Five-Year Plan to further certify the policy-making.

This paper will briefly introduce the principle of the hybrid reactor and make certain comparisons with regard to the superiority of the hybrid reactor.

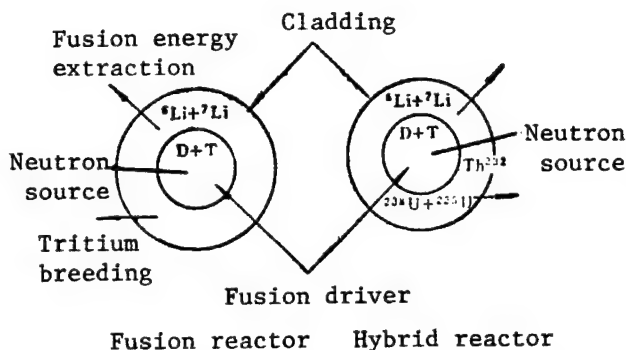


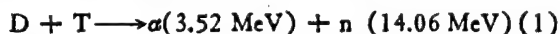
Figure 1. Comparison of Fusion Reactor and Hybrid Reactor

## I. Principle of the Fusion-Fission Hybrid Reactor

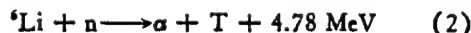
### 1. Nuclear Physics Foundation of the Hybrid Reactor

The hybrid fusion-fission reactor has a fusion core as driver. Outside the reactor core is breeder cladding. The cladding is a subcritical apparatus. Figure 1 is a comparative diagram of a pure fusion reactor and a hybrid reactor. The primary difference between the two is that in the hybrid reactor cladding the fissionable [5142 2436 fertile material] nuclei  $^{238}\text{U}$  or  $^{232}\text{Th}$  is increased and there are sometimes also other fissionable nuclei  $^{235}\text{U}$  and  $^{239}\text{Pu}$  or  $^{233}\text{U}$ .

The first generation fusion reactor will be a Deuterium-Tritium reaction fusion reactor. The thermonuclear reaction which takes place in the high temperature plasma in the fusion reactor core is:



produces 14 MeV fast neutrons which enter the cladding through the first barrier. Like a pure fusion reactor, the fast neutrons enter the hybrid reactor cladding and the reaction with Lithium creates Tritium to supplement the Tritium consumed in the fusion reaction:



However the difference between a hybrid reactor and a pure reactor is that after the fast neutrons enter the cladding, in addition to creating a Tritium reaction, a (n, gg) capture reaction occurs with  $^{238}\text{U}$  or  $^{232}\text{Th}$  and the nuclear fuel  $^{239}\text{Pu}$  or  $^{233}\text{U}$  which is created thus plays a role as fertile nuclear fuel.

The fusion neutrons can also have a fast fission reaction with the  $^{238}\text{U}$  and  $^{232}\text{Th}$  (threshold values are 0.7 MeV and 1.2 MeV, respectively), and after slowing, hot neutron fission can occur with  $^{235}\text{U}$ ,  $^{239}\text{Pu}$  or  $^{233}\text{U}$ . The

fission energy deposited in the cladding by each fission is approximately 190 MeV, and thus acts to multiply the energy.

Through (n, 2n), (n, 3n) reactions with the first barrier material, fissionable nuclei and neutron multiplier (such as Be, and Pb) the fission neutrons the goal of multiplying neutrons can be achieved.

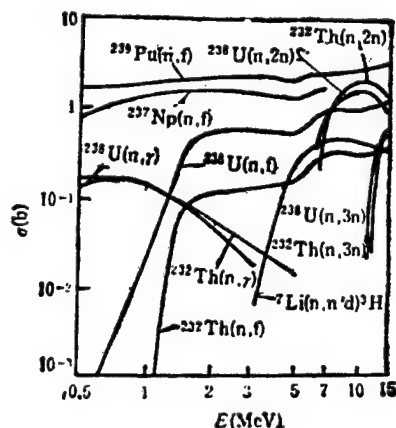
Figure 2(a) is a cross section of significant fuel nuclei fast neutrons in a hybrid reactor. Figure 2(b) is a cross section of several non-fuel nuclei (n, 2n), (n, 3n). Through fission, (n, 2n), and (n, 3n) reactions, a fission neutron in the hybrid reactor cladding can generally be multiplied to 2-4 neutrons. Apart from one neutron which is used for breeding Tritium, 1-3 neutrons can be used for breeding nuclear fuel or increasing fission. This is called the net breeder ratio.

$$(C_{BR}^H).$$

The fast reactor neutron spectrum is rather soft. In a fast reactor,  $^{238}\text{U}$  and  $^{232}\text{Th}$  fast fission is rare, there is no (n, 2n), (n, 3n) reaction, neutron multiplication is poor and the breeding ratio is low. When hybrid sodium oxide cools the fast reactor, the breeding ratio can only reach 1.1-1.3. In the future, use of carbides or metallic fuel it may reach 1.4-1.5. The fuel of each fission breeding has one used for production nuclear fuel to compensate for consumption, the net breeder ratio can only be 0.1-0.3, and in future at most can be 0.4-0.5.

$$(C_{BR}^{FR})$$

The ratio of annual nuclear fuel production capability of hybrid reactors and fast reactors (Y) is the ratio of product of the fusion reaction rate ( $R_f$ ) and the cladding



(a) Cross section of various fuel nuclear fast neutrons

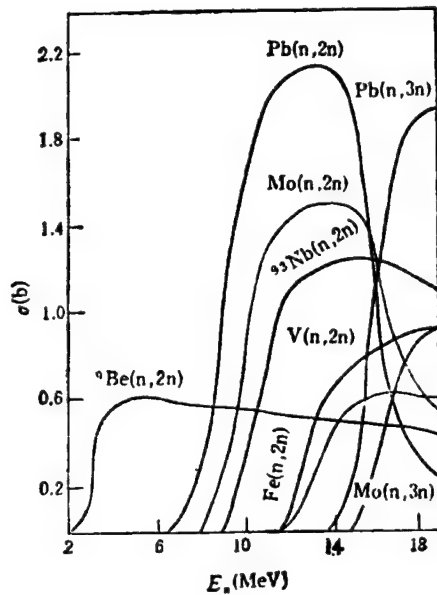


Figure 2

(b) Cross section of several types of neutron multiplier (n, 2n), (n, 3n)

net breeder ratio of the hybrid reactor and the product of the fission rate ( $R_F$ ) and the net breeder rate of the fast reactor

$$Y = R_F C_{BR}^H / R_F C_{BR}^{FR} \quad (4)$$

For power, it is the same for the P(MW) hybrid reactor and fast reactors

$$R_F / R_F = 190 / (3.52 + 14 M), \quad (5)$$

in which  $M$  is the hybrid reactor cladding energy multiplication factor. Therefore

$$Y = 190 C_{BR}^H / (3.52 + 14 M) C_{BR}^{FR} \quad (6)$$

$$C_{BR}^H > C_{BR}^{FR}$$

This is because therefore when  $M$  is not too great,  $Y > 1$ . It is clear that the hybrid breeding ability of the reactor is much greater than that of the fast reactor.

## 2. Two Types of Hybrid Reactors

Any deuterium or tritium neutron source can be the driver of a hybrid reactor, even if the accelerator neutron source, such as a spallation source also can be the driver of a hybrid reactor. Hybrid reactors can be divided into two major classes of magnetically confined hybrid fusion-fission reactor and inertially confined hybrid fusion-fission reactor depending on the differences in hybrid reactor

driver. Examples of the former are Tokamak hybrid reactors and tandem magnetic mirror hybrid reactors; examples of the latter are laser inertially confined hybrid reactors and hybrid particle beam fusion reactors. Inertially confined hybrid reactors do not require a strong magnetic field, structure is simple, reactor core power density is high, economics are good, and maintenance is easy. The structure of magnetically confined hybrid reactors is complex, they require a strong magnetic field, reactor core power density is low and economic performance is relatively poor. However, research on Tokamak fusion devices is well advanced and first generation hybrid reactors will be Tokamak hybrid reactors.

Hybrid reactors are divided on the basis of fuel systems into U/Pu system hybrid reactors and Th/U system hybrid reactors. After breeding nuclear fuel generally goes through postprocessing to extract the breeder Pu or  $^{233}\text{U}$ . Recently with the development of neutronics, a new idea has been suggested, i.e., after breeding to a certain isotope density, such as 3 percent  $^{233}\text{U}$  content, it can be used in a thermal reactor without going through processing. This type is called the direct enriched hybrid reactor. It can save the expenses of postprocessing which is beneficial for lowering fuel costs and advancing commercial use.

Fission hybrid reactors and retarded fission reactors can be designed on the basis of the differences between the nature and degree of the fission induced after 14 MeV neutrons enter the cladding. Hybrid fission reactors use  $^{238}\text{U}$  and  $^{232}\text{Th}$  fast neutron fission (fast fission hybrid reactor) or post-moderation thermal neutrons and  $^{235}\text{U}$  in the cladding and the thermal neutron fission of the  $^{239}\text{Pu}$  or  $^{233}\text{U}$  produced (thermal neutron fission hybrid reactor). Since fission hybrid reactors use fission energy, the energy accumulated in the cladding can be many times greater than that of the pure fusion reactor. If in the design of the hybrid reactor, 14 M neutrons are rapidly moderated below the fission threshold of  $^{238}\text{U}$  or  $^{232}\text{Th}$  so that fast fission is avoided as much as possible and at the same time the  $^{239}\text{Pu}$ ,  $^{233}\text{U}$  and  $^{235}\text{U}$  content of the cladding is lowered as much as possible to avoid thermal fission, then the fusion neutrons which are multiplied in the cladding can be used as much as possible as nuclear breeder fuel and such a hybrid reactor is called an inhibited fission reactor. The energy multiplication of such a reactor is not great, but the nuclear fuel production is considerable, so it is called a nuclear fuel plant.

energy released by each fission reaction  $N = \frac{\text{energy released by each fission reaction in a hybrid reactor}}{\text{energy released by each fusion reaction in a hybrid reactor}}$

— energy released by each fusion reaction in a hybrid reactor

$$= \frac{190}{14.06 M + 3.52} \frac{C_{BR}}{1 - \epsilon}$$

$$= \frac{13.5}{1 - C} \frac{C_{BR}}{M} f(M),$$

in which  $C_{BR}$  is the net breeder ratio,  $M$  is the cladding energy multiplier factor,  $c$  is the fission reactor fuel conversion ratio,

$$f(M) = 14.06 M / (14.06 M + 3.52).$$

$$N = 33.7 \frac{C_{BR}}{M} f(M)$$

for  $^{239}\text{Pu}$  pressure water reactor

$$(c = 0.6), \quad (7)$$

$$N = 54.0 \frac{C_{BR}}{M} f(M)$$

for  $^{233}\text{U}$  pressure water reactor

$$(c = 0.75). \quad (8)$$

Table 1 is a representative example of the support ratios of different hybrid pressure water reactors. On the basis of different demands, hybrid reactors which are primarily for production of nuclear fuel or primarily to power production or a combination of the two can be designed.

Table 1. Support Ratios of Different Cladding Hybrid Reactors Relative to Pressure Water Reactors

	M	$C_{BR}$	$^{239}\text{Pu}$ N	$^{233}\text{U}$
Fast neutron fission (power reactor)	25	1.04	1	2
Fast fission	10	1.6	5	8
Controlled fission	2	0.92	14	22

### 3. Hybrid Reactors Can Advance Use of Fusion Energy

The more fission energy produced by hybrid reactor cladding, the greater the increase in cladding energy, the lower the demands on the fusion driver, which is beneficial for advancing the implementation of fusion energy use.

The average deposited energy of each fusion neutron in the cladding is

$$E_b = M q_n, \quad (9)$$

$q_n$  is the fusion neutron energy. The hybrid reactor cladding power is

$$P_b = R_f E_b = M q_n R_f, \quad (10)$$

$R_f$  is the fusion reaction rate of the fusion reactor core. For a hybrid reactor with a definite cladding power,

$$R_f = \frac{P_b}{q_n} \cdot \frac{1}{M}, \quad (11)$$

$P_F$  = fusion power =

$$= R_f (q_a + q_n) = \frac{P_b (q_a + q_n)}{q_n} \cdot \frac{1}{M}, \quad (12)$$

$Q$  = energy gain =

$$= \frac{R_f (q_a + q_n)}{\tau P_b} = \frac{(q_a + q_n)}{\tau q_n} \cdot \frac{1}{M}, \quad (13)$$

$I$  = first barrier neutron load =

$$= \frac{R_f q_n}{A} = \frac{P_b}{A} \cdot \frac{1}{M}, \quad (14)$$

in which  $q_a = 3.52$  Mev,  $A$  is the first barrier area,  $gg$  is the portion of cladding power used for reactor core input energy. The demands of a fusion reactor or hybrid fusion-fission reactor with a fixed cladding power on the fusion driver forms an inverse ratio with  $M$ . Therefore, the hybrid reactor (especially the hybrid fission reactor) can greatly lower the difficulty of a fusion driver technologically. Table 2 is the demands of different cladding on the  $Q$  value (assuming  $gg = 5$  percent).

**Table 2. Demands of Different Cladding on Fusion Reactor Core Q Value**

	Thermal neutron hybrid reactor	Fast fission hybrid reactor	Controlled fission hybrid reactor	Pure fusion reactor
Av cladding energy multiplier factor (M)	25	10	2	1.3
Demand on effective power output gain (Q)	1	2.5	12.5	19

It is all right if the demands of hybrid fission reactors on the Q value reach 1-2. The Q values of the current four major ignition devices internationally TFTR, JET, JT-60 and T-15 is about 1-4. After these devices realize ignition, an engineering experimental hybrid fusion-fission reactor can be constructed on the basis of this generation of devices. The Tokamak fission hybrid reactor can be implemented first of all. According to statistics, it can be about 20 years ahead of the pure fusion

reactor. If at first it is only used for producing nuclear fuel and not connected to a network for transmission of electricity, it still can be moved ahead. A controlled hybrid fission reactor is the ideal nuclear fuel plant. Since the demands on the driver are not lowered much, the construction time will be more delayed than the hybrid fission reactor.

## II. Comparison of Two Types of Breeder Reactors

To explain the advantages of hybrid reactors, we will first make some comparisons of the fusion breeder reactor (hybrid reactor) and the fission breeder reactor (fast reactor).

### 1. Hybrid Reactor Breeder Energy Is Much Greater Than Fast Reactors

Above we have mentioned that the pure breeder ratio of fast reactors is small, multiplication time is long (for example Super-Fenghuang-1 breeder ratio is 1.1 and multiplication time is 40 years), the nuclear fuel breeder capability is poor, and the support ratio is much smaller than that of the hybrid reactor. Table 3 is the typical range of a fast reactor and hybrid reactor with regard to pressure water reactor support ratio.

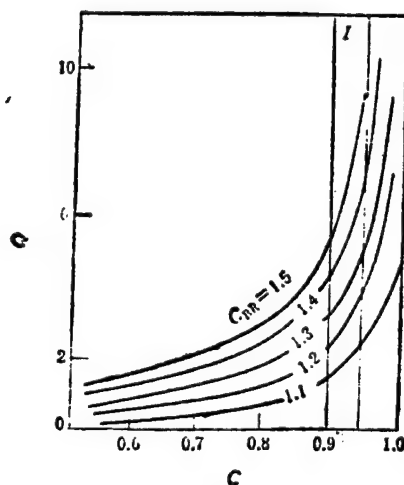
**Table 3. Fast Reactor and Hybrid Reactor Support Ratios Relative to Pressure Water Reactors**

	Oxide fast reactor	Carbide fast reactor	Metallic uranium fast reactor	U/Pu fast fission hybrid reactor	Th/U fast fission hybrid reactor	Th/U controlled fission hybrid reactor
$C_{BR}$	0.1-0.3			1.5-2	1.8-2.5	0.6-0.85
M				8-12	10-14	2.5-1.6
N	0.25-0.7			4-6	8-12	12-15

P. Fortescue has carried out theoretical comparison of the breeder energy of a fusion breeder reactor and a fission breeder reactor<sup>[10]</sup>. See Figures 3(a) and 3(b). Q is the energy multiplication, relative to the support ratio (here the fast reactor  $C_{BR}-1$  is the pure breeder ratio).

### 2. The Hybrid Reactor Is Not Inhibited by Industrial Plutonium

Fast reactor power station construction was inhibited by initial fueling with industrial plutonium, but the hybrid reactor does not have this problem. The Super-Fenghuang-1 fast reactor initial fueling required 8 t of industrial plutonium in the reactor with an annual output of 200 kg of plutonium. After the oxide sodium cooled fast reactor was transformed, the best circumstances were estimated to be initial fueling of 5 t and annual output of 250 kg of plutonium. In the future, using carbide or metallic uranium fuel, the initial fueling can reach 3 t with annual output of 300 kg of plutonium, but it will still be inhibited by the initial fueling with industrial plutonium.



(a) Fast reactor breeder capability (Q = conversion reactor power/fast reactor power, c is the thermal reactor conversion ratio,  $C_{BR}$  is the breeder ratio)

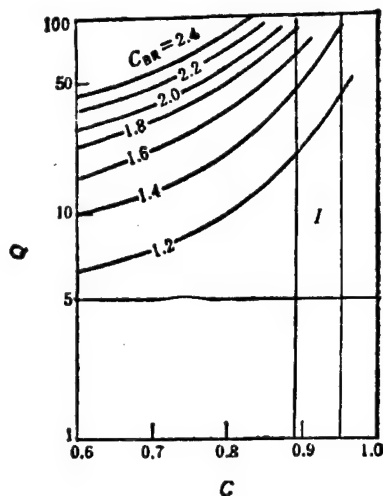


Figure 3

(b) Hybrid Reactor Breeder capability ( $Q$  = fission energy/fusion energy,  $c$  is the thermal reactor conversion ratio,  $C_{BR}$  is the net breeder ratio)

China's rated electric power generating capacity by the year 2000 is estimated to reach 230 GWe and if the average annual increase after the year 2000 is 4 percent then the gross rated capacity by the year 2050 will be about 1635 GWe (curve IV in Figure 4). It is said that China's uranium mine explored reserves can only supply 15 GWe pressure water reactors for 30 years. With U/Pu circulation it also can only be 21 GWe. China's nuclear power station construction is too late and too slow and extremely unfavorable for accumulating industrial plutonium growth fast reactors. If 15 GWe nuclear power is built before the year 2010, and another 10 GWe added between the years 2011 and 2015, then the total will reach 25 GWe by the year 2015. If fast reactors are introduced beginning in the year 2010 and all industrial plutonium produced by pressure water reactors and fast reactors is used to develop fast reactors, then the nuclear power rated capacity provided by pressure water reactors and fast reactors with different breeding capabilities together are illustrated by curves I, II, and III in Figure 4. From Figure 4 it is clear that fast reactors cannot resolve China's energy problem in the 21st century.

Hybrid reactor construction is not inhibited by accumulation of industrial plutonium, and as soon as the technology matures and economic forces permit, development can be accelerated. If we can concentrate our forces and work hard then hybrid fission reactors can go into operation in China in the year 2015, and it is possible that about the year 2020-2025 controlled fission hybrid reactors can go into use. Since the hybrid breeder reactor's capacity is powerful, soon after construction it can supply fuel for pressure water reactors. The above-mentioned 25 GWe nuclear power station

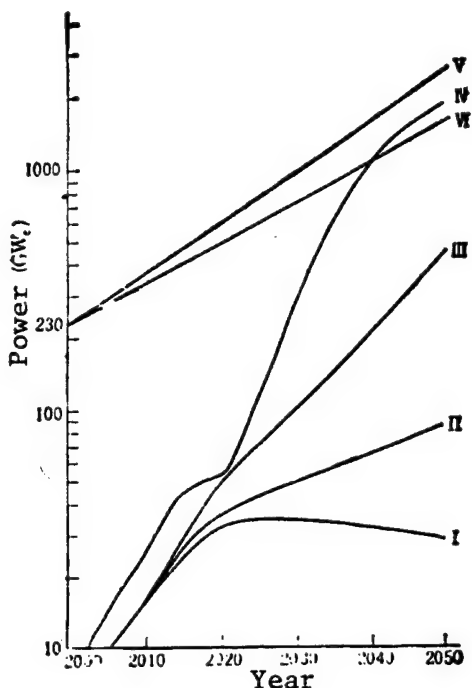


Figure 4. Nuclear power which can be provided by different breeder reactor systems Curve I is fast reactor + LWR, initial fueling 6 t, annual output of plutonium is 150 kg; Curve II is fast reactor + LWR, initial fueling 5 t, annual output of plutonium is 250 kg; Curve III is fast reactor + LWR, initial fueling 3 t, annual output of plutonium is 300 kg; Curve IV is hybrid reactor + LWR, year 2020 introduction of fission hybrid reactor (support ratio 6), year 2025 introduction of controlled fission hybrid reactor (support ratio of 20); Curves V and VI are China's needs for electric power increase (V is annual increase of 4 percent after the year 2000, VI is annual increase of 5 percent after the year 2000)

fuel can be used for a total of 750 reactor-years. While the pressure water reactors will use low concentration natural uranium for the first 15-20 years, later they can use fuel supplied by hybrid reactors. Thus in the early period, more pressure water reactors can be built. If each year we begin to construct one fast fission hybrid reactor-pressure water reactor system with a support ratio of 6 and after the year 2025 add two more per year; then after the year 2025 we construct one controlled fission hybrid reactor co-generation system (support ratio of 20) and after the year 2030 add two per year, then according to this plan the nuclear power electricity rated capacity of the hybrid reactor-pressure water reactor co-generation system will be as illustrated by curve VI in Figure 4. This shows that the hybrid reactor-pressure water reactor co-generation system will provide a possible road for resolving the problem of the energy shortage in China in the 21st century.



### 3. The Price of Electric Energy of the Hybrid Reactor-Pressure Water Reactor Co-Generation System Is Cheaper Than the Fast Reactor-Pressure Water Reactor Co-Generation System

Figure 5 is the U.S. EPRI evaluation of power plant prices of several types of fuel circulation<sup>[11]</sup>. In the figure, OT + F is the fast reactor (construction cost ratio for LWR is higher by 30 percent, multiplication time is 15 years) + LWR (one pass) co-generation system; D + H<sub>1</sub>, D + H<sub>2</sub>, D + H<sub>3</sub>, D + H<sub>4</sub> are hybrid reactor + LWR (U/Pu circulation) co-generation systems. Hybrid reactor co-generation system power plant prices are cheaper than fast reactor co-generation systems. OT is one pass LWR; D is U/Pu circulation LWR. H is the hybrid reactor, whose performance is illustrated in Table 4.

Table 4. Various Hybrid Reactor Conditions

Hybrid reactor	Construction cost (LWR)	Support ratio	Net electricity output (MWe)
H <sub>1</sub>	1.5	4	800
H <sub>2</sub>	2.5	4	800
H <sub>3</sub>	2.5	12	100
H <sub>4</sub>	2.5	8	800

### 4. Hybrid Reactor-LWR Co-Generation System Consumption of Uranium Resources Is Lower Than Fast Reactor-LWR Co-Generation Systems

Figure 6 is the relationship of world uranium consumption according to the OECD world nuclear power prediction low scheme analysis and different systems and fuel circulation<sup>[12]</sup>. In the figure FB is LMFBR + LWR, HP is U/Pu circulation hybrid reactor + LWR, HU is Th/U circulation hybrid reactor + LWR. Obviously, HP and HU are lower than FB. The horizontal line is the believed world uranium reserves. Clearly, only the hybrid reactor co-generation system can maintain the use of uranium consumption below  $5 \times 10^6$ t. In Figure 6, OT is one pass LWR; LU is LWR uranium circulation; LU-LP is LWR U/Pu circulation.

From Figure 6 it is clear that if it is one-pass LWR, then the world uranium deposits will be used up by the year 2020. Using the U/Pu circulation and fast reactor + LWR co-generation system, it will be used up before the year 2040. If the time that the fast reactor is introduced and promoted is retarded, then the time when the uranium consumption ends will be advanced.

### 5. Th/U System Hybrid Reactor-LWR Co-Generation System Is Economical Compared to Use of Thorium Resources, and Fast Reactors Cannot Economically Use Thorium Resources

Since the  $^{232}\text{Th}$  fast neutron fission cross section is much smaller than the  $^{238}\text{U}$  fast fusion cross section, the  $^{232}\text{Th}$  fission threshold (1.2 MeV) is much higher than that of

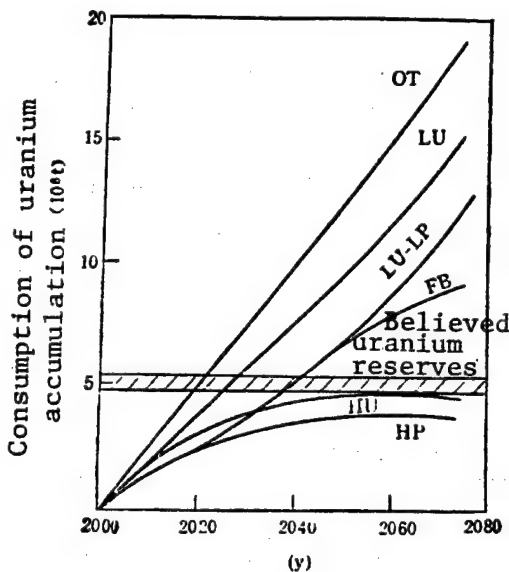


Figure 6. World uranium consumption according to predicted low nuclear power (assuming new type reactors are introduced in the year 2000 and according to market penetration model)

$^{238}\text{U}$  (0.7 MeV), in a hybrid reactor Th/U system has many more neutrons than the U/Pu system to be used for breeding nuclear fuel but the  $^{232}\text{Th}$  and  $^{238}\text{U}$ 's capture surfaces are about the same. Therefore, in a hybrid reactor, the Th/U system breeder performance is better than the U/Pu system and under controlled fission circumstances it is even more the case. In addition, the gh value of the  $^{233}\text{U}$  in the thermal zone is higher than  $^{239}\text{Pu}$  (for  $^{233}\text{U}$ ,  $gh = 2.2966$ ; for  $^{239}\text{Pu}$ ,  $gh = 2.1137$ ), therefore in thermal reactors burning  $^{233}\text{U}$  is more economical than burning  $^{239}\text{Pu}$  ( $^{233}\text{U}$  is 0.14 kg/MW.y,  $^{239}\text{Pu}$  is 0.2 kg/MW.y). In the hybrid reactor-LWR co-generation system, the support ratio of Th/U system is greater than that of U/Pu system, thorium utilization is also more economical, and the controlled fusion hybrid reactor Th/U system is especially beneficial.

In the fast reactor, because the gh value of  $^{233}\text{U}$  in the high energy neutron zone (100 keV) is much lower than that of  $^{239}\text{Pu}$ ,  $^{232}\text{Th}$  fast fission cross section is much smaller than that of  $^{238}\text{U}$ , but the fission threshold happens to be higher than that of  $^{238}\text{U}$  so the capture cross section is about the same as for  $^{238}\text{U}$ . Therefore, in fast reactors, the breeder performance of both  $^{233}\text{U}$  and  $^{232}\text{Th}$  is poor, in the overall breeder performance, the Th/U system is about 20 percent lower than the U/Pu system. If a fast reactor uses the Th/U system,  $^{233}\text{U}$  initial fueling and multiplication times are greater than the U/Pu system, economic performance is worse than that of the present uranium plutonium hybrid oxide fast reactors, breeding capability is lower, and even more lacks competitive ability.

China's thorium resources are abundant: surveyed reserves are over 200,000 tons. Developing hybrid reactors may effectively use thorium resources so that China's nuclear fuel resources will be expanded over threefold.

### 6. Hybrid Reactors Are Safer Than Fast Reactors

First, hybrid reactors are a one time critical device; second, the reactor after heat problems are fewer than the fast reactor's, the controlled fission hybrid reactor is safer than the LWR, fission rate is extremely low (each fusion in the cladding induces a fission number of unloaded fuel product is only 1/60 that of the LWR); third, in fluidized bed combustion circulation nuclear fuel in the reactor can leak out during an emergency shutdown and there is the problem of melting inside the reactor; fourth, direct enriched hybrid reactor does not have a post-processing problem; fifth, when the hybrid reactor-satellite reactor co-generation system requires post-processing, all the waste elements in the satellite reactors can be concentrated in the hybrid reactor plant for processing.

### 7. Other Advantages

Hybrid has a series of advantages which the fast reactor lacks. For example, the hybrid reactor can produce isotopes of  $^{239}\text{Pu}$  which can be more than 95.5 percent pure; it can build a tritium reactor; there is the possibility that it can become a way for final processing of wastes with long radioactive lives; it can construct a high temperature heat source of more than 1000SDC taking the place of high temperature gas-cooled reactor and used for coal gasification, production of hydrogen, and organic synthesis of methane, alcohol, gasoline.

Another important function of hybrid reactors is that they act as an intermediate stage in the transition to pure fusion reactors and can be second degree test reactors for pure fusion development to test materials and equipment, and accumulate design, construction and operational experience. Yet the fast reactor serving as a transitional reactor is completely independent and has no direct relationship to fusion development.

From the several points cited above it can be seen that the superiority of the hybrid reactor compared with the fast reactor is clear. The issue that concerns everyone now is what is the feasibility of the hybrid reactor. With regard to this point, development of the fast reactor is naturally mature, prototype reactors are already connected to networks and transmitting electricity. For a hybrid reactor to develop to today's stage of the prototype fast reactor would take about 15 years. There are many engineering and technical problems that must be resolved in hybrid reactor development. However, construction of a hybrid reactor has already been resolved in principle, and at the same time since in terms of engineering and technology it is based on the foundation of existing fission reactor and fusion reactor engineering

research, there are no insuperable problems, construction is possible, there is only the problem of time. China's development of breeder reactors is to resolve the problem of shortage of energy in the 21st century. Technological maturity is a necessary condition for introducing an energy source system, but it is not a complete condition. Whether or not it can, or to what degree can resolve China's energy shortage in the 21st century is the complete condition. From this angle, proceeding from the actual circumstances in China, China's development of breeder reactors by taking the path of hybrid reactors seems to be the best policy.

### III. Developing Hybrid Reactors Is an Important Challenge and Opportunity Facing China

It was mentioned above that although there are difficulties in developing hybrid reactors a feasible path has already been realized. Internationally, since there are great difficulties in developing pure fusion reactors, construction time may be more retarded than previously thought. Thus the cry for hybrid reactors as an intermediate stage has been higher and higher. For the USSR making the hybrid reactor the first stage in utilizing fusion energy is already policy. At the 10th International Plasma and Nuclear Fusion Conference, Soviet Academician E.P. Velikhov announced that the Soviet Union would make hybrid reactors for generating electricity and producing nuclear fuel the first step in utilizing fusion energy and announced the indicators of a Tokamak hybrid reactor engineering test reactor OTR based on the T-15<sup>[13]</sup>. This reactor is estimated to be completed before the year 2000. The Soviet Academician Basov pointed out in a 1984 article<sup>[14]</sup>, that in laser fusion the Soviet Union had planned a pure fusion reactor, a fission hybrid reactor for motive power, controlled fission hybrid reactor-fission reactor power station co-generation system. And he pointed out that the hybrid reactor's demand for laser efficiency could be lowered from 5 percent to 0.5 percent. At the 1986 Madrid Conference, Soviet Academician Basov and others gave reports on the concept and design of laser constraint hybrid reactor<sup>[15]</sup> and pointed out that costs of generating electricity could be lower than conventional nuclear electricity.

U.S. hybrid reactor research was the earliest and they have done the most work. Uranium and oil prices dropped due to the energy glut and at the same time because of preventing nuclear proliferation and anti-nuclear influence fast reactors and hybrid reactors did not receive congressional support. Recently, due to the great difficulties of pure fusion, seeing that the Soviet Union is committed to developing hybrid reactors, the call for hybrid reactors in the United States has also increased. In 1985 the Department of Energy organized a committee of specialists to conduct 9 months of evaluation of hybrid reactors. Due to economic, political and social factors, U.S. development of hybrid reactors will not go smoothly.

The person in charge of West European fusion, D. Palumb, indicates that Western Europe is engaging in pure fusion reactors and is not prepared to engage in hybrid reactors, because 1) Western Europe has invested in the development of fast reactors, that have enough industrial plutonium; 2) the anti-nuclear movement is too powerful; 3) they have no place to build hybrid reactors. He recognizes that only the Soviet Union and China have the conditions to engage in hybrid reactors.

After the Third International New Nuclear Energy System Conference, the hybrid reactor began to be taken seriously by more countries. Japan<sup>[16]</sup> and India have begun actively developing hybrid reactors.

Western Europe, the Soviet Union, and the United States have a history of development hybrid reactors of more than 30 years. That have sufficient accumulation of industrial plutonium. It is natural for them to take the fast reactor route. Developing hybrid reactors would not be difficult for them technologically speaking. However, due to political, economic and social influences, except for the Soviet Union, it will be difficult for them to take the hybrid reactor route.

China has a foundation of 30 years of fast reactor work, does not have accumulation of industrial plutonium, and development of fast reactors would not resolve the long-range energy problem. Compared with fast reactors, China's fusion research has two bases and a good foundation. China's path of developing nuclear energy need not take the crooked road of thermal reactor—fast reactor—fusion reactor. In the new technological revolution, we must be far-sighted, strengthen leadership, concentrate forces, and take the path of developing hybrid reactors. In this way we may later dominate. "The opportunity should not be lost, the time will not come again," we cannot let this opportunity pass us by.

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08226/06091

## Compression Of and the Flux Trapped in a Field-reversed Pinch Plasma

40090017 Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 36 No 9, Sep 87 pp 1105-1111

[Abstract of article by Wu Cheng [0702 2052] et al of the Institute of Physics, Chinese Academy of Sciences, manuscript received 20 Dec 85, revised 16 Mar 86]

[Text] A field-reversed pinch plasma discharge device could easily be applied to the construction of a compact toroid in a fusion reactor. The stability of a field-reversed pinch configuration not only is determined by the reversed magnetic flux trapped in the plasma but also is closely related to the compression process and the time evolution of the trapped flux.

Many researchers found that the trapped flux oscillated in their experiments. In the decay process, the number of peaks and the timing were dependent upon the experimental conditions. When two peaks were present, the rising rate and amplitude of the first peak are larger than those of the second peak.

In this work, the compression process is analyzed for a field-reversed pinch plasma on the FRP-1 device. The oscillation and decay of the trapped flux are observed under various discharge conditions. Based on the conservation of the sine of the angular momentum, this phenomenon is quantitatively described. The calculated results are in good agreement with the experimental data.

12553/06662

### **Private Firm Develops Real-Time Communications System**

40080001 Beijing GUANGMING RIBAO in Chinese  
20 Aug 87 p 2

[Summary] The Fuzhou Shidai Computer Applications Research Institute has developed the "TCRTC Chinese Remote Real-Time Communications System," a first for China. The institute was organized 2 years ago by Liu Ximin [0491-6932-3046], as assistant engineer with the Fujian Hydroelectric Department. Although China has communications facilities using computers to transmit data, documents, and reports, such facilities cannot receive incoming transmissions when they are in the functional mode. The TCRTC System, which uses an "intelligent modulator-demodulator" along with a computer, makes it possible to access data and documents and transmit them up to several thousand kilometers away, with reception possible even in the functional mode. Chinese specialists see this system as a useful tool in bringing about office automation and modernization in China. The institute has already sold 300 of these units throughout the country, for a profit of more than 1 million yuan. /09599

### **Southwest Fluid Physics Institute Claims 'World Class' Laser Interferometer**

40080037c Beijing GUANGMING RIBAO in Chinese  
25 Nov 87 p 2

[Article by Xi Qixin [1153 0796 2450]: "Southwest Fluid Physics Institute Develops Advanced Laser Interferometer"]

[Text] A laser interferometer capable of measuring the motion parameters associated with any reflective surface was certified at the ministry level on November 21.

Laser interferometer is an advanced instrument for measuring speed which was first introduced in the United States in the early 1980's. It has become a piece of necessary equipment in advanced laboratories in all developed nations. Because of the importance of this

technology in weapons development and basic research, Western nations have banned its export to socialist countries. In order to satisfy the need in weapons development in China, the Southwest Fluid Physics Institute began to tackle the problem from 1984. It only took 3 years to develop the first laser interferometer. This instrument was tested by relevant institutes under the Ministry of Nuclear Industry and Ministry of Ordnance Industry, and was used in the field by troops under the National Defense Science Commission. All major technical specifications have met leading standards in the world.

The review committee believed that the laser interferometer developed by the Southwest Fluid Physics Institute can continuously measure the velocity of any reflective surface with high accuracy and resolution. It cannot be matched by any other velocity measuring instruments available in China. The wide adaptability and the future prospect of the instrument has made a significant contribution to the use of "world class" laser interferometer for velocity measurements in China.

12553/06662

### **Control Rod Drive Line Test in High Temperature Still Water for Qinshan Nuclear Power Plant**

40090013 Chengdu HE DONGLI GONGCHENG  
[NUCLEAR POWER ENGINEERING] in Chinese  
Vol 8 No 4, Aug 87 pp 10-14

[Article by Zhang Yulin [1728 5940 2651], Su Yaozu [5685 5069 4371], Can Yingen [5591 6892 2704], Zhang Jinpin [1728 6855 0756], Hu Zhenxiao [5170 2182 1321], and Jing Yi [2529 4135]

[Abstract] The control rod drive line high temperature still water experiment is a large comprehensive experiment in the design of the Qinshan Nuclear Power Plant. The entire drive line is made up of a magnetic lift drive mechanism, guide tube module, fuel module and control rod module as well as a Gray code rod position indicator and drive mechanism power supply control device. The dimensions of each part of the drive line were completely analogous to those of the plant and, except for the fuel core, the materials, dimensions and industrial processing were completely identical to the product. 1,340 scram were carried out on this test equipment. The control rod module operated smoothly in the drive line direction. Total time to lower the control rods over 2.75m was measured at temperatures ranging from 27xC to 300xC and was found to range from 1.53s to 1.64s, with an average of 1.58s. At 300xC the ultimate velocity of lowering the control rods was 0.55m/s. Temperature had a considerable influence on the density and viscosity of the water, but pressure had only a minute influence. The hydraulic damping of the control rods was calculated as found to satisfy the design demands of a rod lowering time of less than 2s and an ultimate velocity of less than 1m/s. The implications of these findings are discussed.

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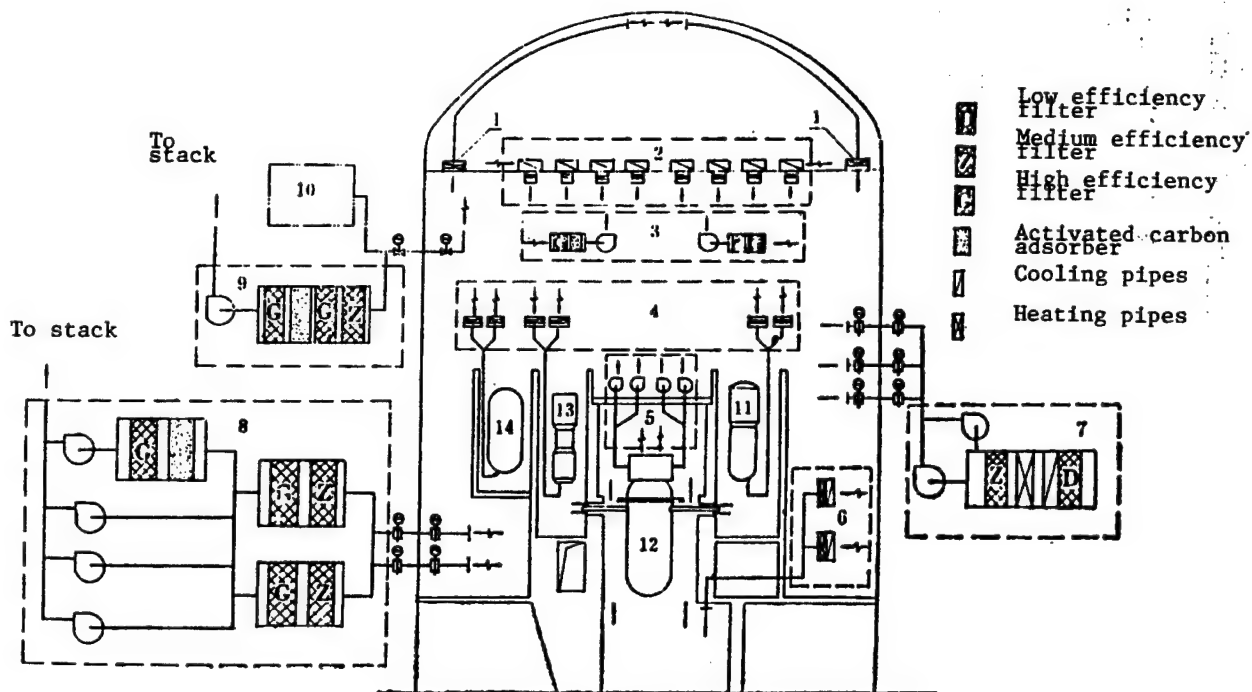


Figure 1.

Key: 1. Containment structure hydrogen mixing system 2. Containment structure air-cooling system 3. Containment structure circulation filtering system 4. Equipment room cooling system 5. Control rod drive mechanism cooling system 6. Reactor chamber cooling system 7. Containment structure cleaning intake system 8. Containment structure cleaning exhaust system 9. Containment structure hydrogen exhaust system 10. Industrial process hydrogen elimination system 11. Steam generator 12. Reactor 13. Main pump 14. Voltage regulator

### Ventilation of Containment for PWR Nuclear Power Plant

40090013 Chengdu HE DONGLI GONGCHENG  
[NUCLEAR POWER ENGINEERING] in Chinese  
Vol 8 No 4, Aug 87 pp 25-30

[Article by Chi Wei [3069 5517]]

[Abstract] This article discusses the functions of containment structure ventilation (heat exhaustion, air filtering, cooling, maintaining a tolerable working environment, and controlling hydrogen concentrations). It also discusses criteria for containment structure ventilation systems in terms of safety levels, continuous operation, redundancy and backup, environmental conditions, earthquake resistance, power supply, instrumentation and control, and structure testing. The subsystems of the primary shell ventilation system are described: structure cooling, reactor chamber cooling, equipment room cooling, control rod drive mechanism cooling, shell circulation filtering, ventilation cleaning, hydrogen mixing and removal. The operation of the ventilation system is described under normal conditions, under cold shutdown and refueling, under loss of electric power and

during water loss. The application of these criteria to the design of the containment structure ventilation system of the Qinshan Power Station is discussed. [Refer to above graphic]

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### Trial Research on Ventilative Well-Distributivity under Normal Temperature for Control Rod Drive Mechanism

40090013 Chengdu HE DONGLI GONGCHENG  
[NUCLEAR POWER ENGINEERING] in Chinese  
Vol 8 No 4, Aug 87 pp 37-42

[Article by Zhu Longxing [2612 7893 5281]]

[Abstract] The Qinshan nuclear power plant uses air-cooling for the magnetic lift control rod drive mechanism. It is important to determine the maximum temperature the electromagnetic coil temperature can bear, what type of vent hood and ventilation method can guarantee even distribution of air, and how great the ventilation resistance can be. The air cooling device was subjected to tests to find answers to these questions. The test devices included sensors placed on the control rods and a grid equipped with sensors to measure air pressure, air velocity, and air volume was placed around the



control rods. As a result of these tests, it is recommended that a ventilation device has 1) a large as possible static chamber capacity for regulation, 2) as large as possible a hood induction inlet area to lower induction inlet velocity, 3) induction inlet area around at the hood distributed as evenly as possible and 4) equal air volume at each air gap. This will achieve excellent distribution and a lower resistance coefficient.

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**Stream Function Solution of Transonic Flow Along Arbitrary Twisted  $S_1$  Stream Surface**

40090044a Beijing GONGCHENG REWULI XUEBAO [JOURNAL OF ENGINEERING THERMOPHYSICS] in Chinese Vol 8 No 4, Nov 87 pp 340-342

[English abstract of article by Zhao Xiaolu [6392 2556 6424], et al., of the Institute of Engineering Thermophysics, Chinese Academy of Sciences]

[Text] The effects of fully three-dimensional flow in a transonic turbomachine's passage are stronger than in a subsonic one. The full three-dimensional solution may be more exact than the quasi-three-dimensional one.

Based on a stream-surface coordinate system in which a coordinate surface coincides with an arbitrarily twisted  $S_1$  stream surface, a principal stream function equation governing the transonic flow has been established. The mixed-type equation can be solved by a traditional artificial compressibility method. The standard conservative differences have been used to discretize the equation obtained, and a constant coefficient matrix decomposition method has been used to speed up the calculation. In terms of the integration velocity gradient equation, the velocity distribution can be determined first, following determination of the stream pattern, then the densities can be updated. Sample calculations are presented to illustrate the method's capabilities.

9717/9604

**Effect of Boundary Layer on Transonic Cascade Flow**

40090044b Beijing GONGCHENG REWULI XUEBAO [JOURNAL OF ENGINEERING THERMOPHYSICS] in Chinese Vol 8 No 4, Nov 87 pp 343-345

[English abstract of article by Hua Yaonan [5478 5069 0589], et al., of the Institute of Engineering Thermophysics, Chinese Academy of Sciences]

[Text] A computational method to include viscosity in transonic cascade flow is presented in this paper. The Stream Function Method is used to calculate the inviscid blade-to-blade transonic flow. Assuming that the viscous effect only occurs in the boundary layer on the blade surface, the Reference Enthalpy Method is used to

calculate the characteristic parameters of the compressible boundary layer. The inviscid-viscous interaction procedure is used to calculate the entire blade-to-blade flow field.

The effect of the boundary layer on the computation results involving inviscid flow is investigated in this paper. Four typical examples of transonic cascades have been calculated using the present method. The results obtained show that the effect of the boundary layer on the inviscid flow is considerable. The calculation results of the inviscid-viscous interaction are closer to the experimental data than the inviscid calculation.

The present method can be used to improve the computation results of inviscid flow. It is an effective and convenient method for use in engineering practice.

9717/9604

**Effect of Interblade Phase Angle in Oscillating Cascade on Unsteady Aerodynamic Force**

40090044c Beijing GONGCHENG REWULI XUEBAO [JOURNAL OF ENGINEERING THERMOPHYSICS] in Chinese Vol 8 No 4, Nov 87 pp 346-348

[English abstract of article by Chen Zuoyi [7115 1563 0001], et al., of Qinghua University]

[Text] Some numerical experiments involving the effect of the interblade phase angle in an oscillating cascade on the unsteady aerodynamic force are presented in this article. A comparison of the unsteady aerodynamic force and corresponding aerodynamic safety analysis under different conditions, such as different flow, different oscillating mode, etc., is also given.

9717/9604

**Navy Completes Regional Microcomputer Communications Network**

40080044a Beijing JISUANJI SHIJIE in Chinese 8 Nov 87 p 1

[Summary] A wired-and-radio-transmission, phase-linked, regional microcomputer communications network, covering China's entire seacoast, has been completed by China's navy. This network is the navy's part of an armed forces information processing system, and uses a high-quality military optimum series (0500 series) microcomputer as its node computer for network organization—an advanced idea for China, and an important contribution to the modernization of the entire military's information-processing technology.

The network has three subsystems: network, message processing, and security. The network system has five layers—application, transmission, network, information link, and physical—which provide the other system with various services and ensure prompt transmission of message digital information. The message-processing



system has drafting, editing, receiving, transmitting, storage, query, monitoring, message-printing, and other functions. The security system is realized through software. The entire network acts as a scatter(ing) star structure.

This system has a reasonable design, efficient software, tight communication rules, a distinct hierarchy, convenient adaptability to other communication networks, and good security. Formal test results revealed that the system is stable and reliable. Specialists gave it a positive evaluation, and considered its functions—computer organization of the network, local-area network entering the main network, software encryption, radio automatic message transmission, unattended watch—as having originality.

/9738

**Multifunctional Computer Speech-Synthesis Processing System Operational**  
40080044b Beijing JISUANJI SHIJIE in Chinese  
8 Nov 87 p 1

[Summary] Very good results have been achieved by an XF computer speech-synthesis processing system, able to handle Chinese-speech recognition, synthesis, and transmission functions, and developed under a joint effort of the China Xiao Feng Technical Equipment Company and the "Second Artillery" [China's Missile Forces] Command and Control Center.

Employing a Texas Instruments speech system, the overall system is based on a Chinese-made mainline microcomputer. This system formalizes the input time of computer instructions and word groups to achieve a recognition rate above 98 percent, has a response rate fast enough to accommodate real-time control processing, is capable of easily phoneticizing various kinds of Chinese-character inputs, employs rules and computational techniques of artificial intelligence (AI) to resolve homograph difficulties arising in speech synthesis, and achieves point-to-point as well as via-computer-network spoken-message transmission. A development-system software package is provided to the user. Fifth-generation-computer research and the development of AI technology provide a very good software and hardware environment. These observers have judged that this system's performance—especially in handling homonym and homograph problems—equals that of the leading Chinese domestic technology.

/9738

**Hefei 200 MeV Linac Completed**  
40080017 Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 13 Nov 87 p 1

[Excerpts] One of China's major construction projects—the synchrotron radiation facility of the China Science and Technology University at Hefei—has made major

advances: a 200 MeV linear accelerator with a capacity that has reached 219.8 million electron-volts has been completed. Surpassing specifications, it will provide an advanced high-tech tool to further the development of the nation's science and technology. This accelerator has a design capacity of 200 meV and incorporates precision machine, microwave, electronics, computer, and super-high vacuum technologies. S&T personnel from the China University of Science and Technology designed the facility and its core component—the accelerator ring. The entire project took a total of 3 years. The completion of this accelerator, in addition to being used as an injector for the synchrotron, may also be used in research involving nuclear physics, radiochemistry, and free-electron lasers.

/12223

**Beijing Linac Achieves 1000 MeV**  
40080037a Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 8 Dec 87 p 4

[Article by Reporter Zhang Jimin [1728 4949 3046], XINHUA News Agency 7 Dec]

[Text] The linear electron accelerator in the Beijing positron-electron colliding machine project has for the first time energized electrons to the 1000 MeV level. This is not only the highest energy level in China but also is rare in similar accelerators in the world.

The linear electron accelerator, which is over 200 meters long, is one of four major components of the Beijing positron-electron colliding machine. Last May, the researchers used this accelerator to achieve 250 MeV at 750 mA. In the past several months, through further adjustment and testing, it achieved 110 MeV at 200 mA on 5 December. Thus, the design specification was met. It is the first cornerstone for China to develop high energy physics research and synchronous light applications.

The researchers believe that by continuing testing and adjustment it will be possible to extend the energy level to around 1500 MeV in the near future.

12553/06662

**Lanzhou Accelerator Now Has Super-high Vacuum Chamber**  
40080037b Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 18 Dec 87 p 4

[Article: "Lanzhou Heavy Ion Accelerator Achieves Super-high Vacuum"]

[Text] A super-high vacuum of  $10^{-6}$  Pascal was achieved in the 100 cubic meter vacuum chamber in the Lanzhou Heavy Ion Accelerator. It is a major accomplishment in vacuum technology in China, which is praised by

experts, professors and professionals who attended the fourth annual meeting of the nuclear vacuum committee of the Chinese Vacuum Society recently held in Lanzhou.

According to a report in KEXUE BAO, the Lanzhou Heavy Ion Accelerator is one of the three largest units under construction in the world. Its super-high vacuum system is the first completed sub-system which includes a vacuum chamber and the associated pumping system.

A heavy ion beam can only be accelerated in super-vacuum. The finished super-vacuum chamber is the largest and most crucial component of the accelerator. It is approximately 10 meters in diameter and 4.5 meters high. Its volume is 100 cubic meters and it weighs 65 tons.

This extremely complex vessel was successfully pumped down to  $10^{-6}$  Pascal super-vacuum in the first attempt in early September 1986. The vacuum chamber is under tremendous atmospheric pressure, approximately 800 tons on the top and bottom and 100 tons on each of the eight surfaces on the side. Actual measurements indicated that it was designed accurately. The mechanical behavior of the vacuum chamber was also found to be stable. The successful completion of the vacuum chamber is a milestone indicating that China has state of the art technology in the design and construction of complex vacuum systems. This achievement was praised in the 11th International Cyclotron Conference held in October 1986 in Tokyo by scientists from all over the world.

A total of 55 professionals in nuclear vacuum technology from 24 departments such as the Chinese Academy of Sciences, Higher Education System, Ministry of Nuclear Industry, Ministry of Astronautics Industry, Ministry of Electronics Industry, and Ministry of Machinebuilding attended the fourth annual meeting of the nuclear vacuum committee.

12553/06662

#### **High-Speed Microcomputer Image-Processing System Developed**

40080048a Beijing JISUANJI SHIJIE in Chinese  
23 Nov 87 p 12

[Summary] An image-processing microcomputer system developed by Southwest Communications University's Applied Computer Research Institute has recently undergone technical evaluation in Chengdu. The system consists of a high-speed image channel and a TMS 320 high-speed image-processing unit with 64-KB static RAM and a 10 MHz clock, used to raise the computational speed of 8-bit or low-grade 16-bit microcomputers. The image channel has a high-speed AD/DA with up to 256KB frame storage, completely real-time image I/O (industrial TV standard), an analysis capacity of 384 x 312 or 512 x 512, and 64 gray levels. Image input is via TV camera or videocorder. Output is via TV monitor,

CRT display, wire printer, and laser printer. The system is easy to operate and expand, and employs modularized software for the I/O drive, printing level, and various filtering, smoothing, enhancement, and edge-detection programs, as well as for the TMS 320 programs.

Specialists rate its design, norms, and applicability favorably, and judge it as the leader among similar domestic products. In addition to image processing, this system's applications include communications, medicine, public security, and other fields in the pattern-recognition domain.

/9604

#### **Software Developed for Numerically-Controlled Lathes**

40080048b Beijing JISUANJI SHIJIE in Chinese  
23 Nov 87 p 24

[Summary] Northwest Polytechnic University's CAD-/CAM Research Center and State Plant 124 of the Ministry of Aviation Industry have jointly developed two-dimensional interactive microcomputer-aided image-programming software for numerically-controlled lathes. Relatively advanced CAM techniques are employed to carry out functional design of medium-to-small-scale machine parts. The software consists of two parts: a pre-processor program and a post-processor program.

In the pre-processor phase, the designer unites the dissimilar processes of threading, grooving, and straight-line circular arc contouring via an appropriate programming module. A convenient graphic menu provides the interactive interface. Cutting-path generation (displayed on the monitor) and processing of cutting-position information are built-in automatic program functions. The pre-processor also contains a cutting-tool library storing many machine-tooling processes. The post-processor utilizes virtual-interface technology. Dissimilar numerically-controlled lathes may be accommodated by inputting the machine tool's special characteristics into the post-processor for delimitation, after which the machine tool can immediately receive the post-processor's output instruction code format.

The software was developed for an IBM-PC/AT using ISO-7942 GKS subset (PC GKS) as the graphics support software, and FORTRAN as the source-program language, and can be run without alterations on IBM PC, PC/XT, Great Wall 0520, and similar compatible computers.

/9604

**National Defense S&T University Develops  
Cannon Test-Processing System**

40080048c Beijing JISUANJI SHIJIE in Chinese  
23 Nov 87 p 24

[Summary] A sufficiently automatic dynamic-parameter test-processing system for measuring data at the instant of cannon firing, for calculating data used in evaluating cannon performance, and for gathering, tabulation, and plotting of data for cannon strain curves has been developed by the Precision Instrument Department of the National Defense Science and Technology University. Passing technical evaluation a few days ago, the system consists of an 86/360 16-bit microcomputer, a 3XST-732 data-acquisition system, a VDU 140 color-graphics display terminal, a Chinese-and-romanized headline printer, and an 8-pen intelligent mapping instrument.

The system has these functions: (1) graphic display, graphic drawing and printing, and—especially re transient wave forms—waveform display/storage/reshowing-/partial enlargement/smoothing and split-screen display; (2) GB two-level hard Chinese-character multiple coding and input modes, a visually attractive character font, and convenient man-machine interaction and printing of Chinese-character reports; (3) statistical analysis, curve fitting, digital wave filtering, and similar methods of eliminating signal interference, on which basis it carries out computerized signal processing, and also draws curves and data tables for evaluating cannon performance.

This system is the first of its kind domestically. It can be used not only for cannon test-data evaluation, but also for equivalent purposes both within and outside of the military.

/9604

**China's First Dataflow Prototype Computer  
System Unveiled**

40080048d Beijing JISUANJI SHIJIE in Chinese  
8 Dec 87 p 1

[Text] The SDS-1 Data Stream prototype computer system, which represents a new generation of Chinese-made computer with great theoretical and practical significance, was recently developed by the National Defense Science & Technology University's Computer Research Institute, and underwent technical evaluation in Changsha on 2 November. The SDS-1 Data Stream prototype computer system is the first Chinese-advanced and Chinese-realized integrated dataflow computational model; it combines control flow and data flow. It is also the first [Chinese]-advanced and [Chinese]-realized dataflow computer developed with parallelism, which is at the complex-function level, opening a way to reduce system overhead and to increase cost performance.

This prototype computer system utilizes a close-coupled multiple-machine system structure that permits simple, direct, and rapid system communications at low expense. The system uses hardware and simulation software in an integrated fashion to achieve all the large units of the dataflow system. Its characteristics include strong functions, good flexibility, and high efficiency, and it can conveniently process various experimental data and be beneficial to research and analysis.

The system can give strong support to the compilation of the functional language VAL and to the execution of the complex-function object code generated in the compiler. It is a powerful tool for researching dataflow high-level languages, dataflow computer system structures, and relevant computational techniques.

The [technical] appraisal recognized the SDS-1 Data Stream prototype computer as China's first dataflow model, and considered the system's concepts—utilization of a synchronous-and-asynchronous-integrated dataflow mechanism as well as development of built-in complex-function concurrency—as having originality. With a rational configuration and very strong functions, the system possesses major value for China's dataflow computer research, meeting advanced international standards of the early eighties.

/9604

**Y-Ba-Cu(Cr) Oxide Superconductors**

40090045a Beijing DIWEN WULI XUEBAO  
[CHINESE JOURNAL OF LOW TEMPERATURE  
PHYSICS] in Chinese Vol 9 No 4, Dec 87 pp 253-255

[English abstract of article by Xianyu Ze [7639 0060 3419], et al., of Northeast University of Technology, Shenyang]

[Text] The authors have obtained a superconductor with zero-resistance temperature  $T_{cf} = 94.1K$ , midpoint transition temperature  $T_c = 95K$ , onset temperature  $T_{ci} = 100K$  and transition width  $gDT_c = 1K$  in the Y-Ba-Cu-O system. The results of X-ray diffraction structural analysis at low temperatures show that a phase transition exists in the multiphase superconductor in the low temperature range (123-173K). Therefore, the authors think that the high  $T_{ci}$  of the multiphase superconductor in the Y-Ba-Cu-O system results from the low temperature phase transition and is not completely the superconducting transition point. Through the substitution of Cr for one-third of the Cu in the oxide system, the authors have also obtained a superconductor with  $T_{cf} = 82.8K$ ,  $T_c = 83.5K$ ,  $T_{ci} = 92 K$ , and  $gDT_c = 1K$ .

09717/09599

**Microstructure of Multiphase Superconductor**  
40090045b Beijing DIWEN WULI XUEBAO  
[CHINESE JOURNAL OF LOW TEMPERATURE  
PHYSICS] in Chinese Vol 9 No 4, Dec 87 pp 260-264

[English abstract of article by Jia Chunlin [6328 2504 2651], et al., of Fudan University, Shanghai]

[Text] The microstructure of a high  $T_c$  Y-Ba-Cu-O superconducting material was studied by TEM. High resolution electron microscopy (HREM) and an electron diffraction pattern (EDP) indicated that there were three phases in the material, which can be represented by Phases A, B, and C, respectively. The crystalline structure of these phases has been investigated using three-dimensional EDP reconstruction. The structure of Phase A is that usually identified as a superconducting phase with a composition of  $YBa_2Cu_3O_7$ , and the contrast disposition of its HREM image coincides well with the positions of metallic atoms in an orthorhombic  $YBa_2Cu_3O_7$  structure proposed by T. Siegrist, et al. HREM also showed that many microdomains and stacking faults along the c-axis and/or defects exist in Phase A. Phase B is an orthorhombic structure, also, with  $a = 0.71$  nm,  $b = 0.555$  nm and  $c = 1.195$  nm. Phase C is a bcc structure with  $a = 1.05$  nm, and is most likely constructed by  $Y_2O_3$ . EDS microanalysis indicated that Y/Cu is somewhat higher and Ba/Cu lower in Phase B than in Phase A. It is suggested that the superconductivity of this multiphase material is mainly determined by Phase A.

09717/09599

**Study of Effects of Phase Structures on Resistivity-Free Superconductivity Temperature in BaYCuO System Ceramics**  
40090045c Beijing DIWEN WULI XUEBAO  
[CHINESE JOURNAL OF LOW TEMPERATURE  
PHYSICS] in Chinese Vol 9 No 4, Dec 87 pp 265-269

[English abstract of article by Zhang Jinxiu [1728 6651 0208], et al., of Zhongshan University, Guangzhou]

[Text] The effects of powdered methods and sintering and heat treatment technology, in addition to phase structures, on the resistivity-free superconductivity temperature have been studied in oxidate ceramics of  $Ba_2YCu_3$  and  $BaY_9Cu_{10}$ . The phase structures of these ceramics have been measured: the crystallographic phase in the  $Ba_2YCu_3$  superconductive oxidate ceramic is mainly quasi-orthorhombic with lattice constants of  $a = 3.840$  Å,  $b = 3.906$  Å, and  $c = 11.718$  Å, respectively. The phases mainly consist of an yttrium-rich body-centered cubic structure and another quasi-orthorhombic structure in the  $BaY_9Cu_{10}$  superconductive oxidate ceramics. The effects of relative contents of phases on resistivity-free superconductivity temperatures have been studied. The maximum temperature obtained corresponding to zero-resistivity is 88.9K.

09717/09599

**Superconductivity of La-Doped  $BaPb_{0.6}Bi_{0.4}O_3$**   
40090045d Beijing DIWEN WULI XUEBAO  
[CHINESE JOURNAL OF LOW TEMPERATURE  
PHYSICS] in Chinese Vol 9 No 4, Dec 87 pp 270-272

[English abstract of article by Fang Yue [2455 6460] et al., of the Institute of Physics, Chinese Academy of Sciences, Beijing]

[Text] The semiconductor  $BaPb_{0.6}Bi_{0.4}O_3$  can exhibit superconductivity when doped with La. Measurements of the variation of lattice constants of the BPB phase in La-doped BPB ( $x = 0.4$ ) prove that the Bi/Pb ratio is changed. The occurrence of superconductivity in La-doped BPB ( $x = 0.4$ ), the authors believe, is due to the change in Bi content in  $BaPb_{0.6}Bi_{0.4}O_3$  induced by the addition of lanthanum.

09717/09599

**Superconductivity, Metal-Semiconductor Transition in La-Sr-Cu-O System**  
40090045e Beijing DIWEN WULI XUEBAO  
[CHINESE JOURNAL OF LOW TEMPERATURE  
PHYSICS] in Chinese Vol 9 No 4, Dec 87 pp 273-275

[English abstract of article by Yu Daoqi [0827 6670 1142], et al., of the Department of Physics, University of Science and Technology of China, Hefei; Zhang Han [1728 6799], et al., of the Department of Applied Chemistry, University of Science and Technology of China, Hefei]

[Text] Compounds with the nominal compositions of  $x = 0.5, 0.75, 1.0, 1.25$ , and  $1.5$  of  $La_{1-x}Sr_xCu_5O_{5(3-y)}$  were prepared under the same conditions. The resistance of these samples was measured between 5K and 150K. The results show that the superconductor-semiconductor-metal (superconductor) transition occurs when the composition of Sr increases from 0.5 to 1.5 in this system. By comparing this system with the  $BaPb_{1-x}Bi_xO_3$  system, the authors suggest that in this system the strong coupling of electron-phonon interaction makes the lattice unstable and a charge-density-wave distortion is likely to happen, which would open a semiconductor gap at  $E_F$ . The distortion would be suppressed when varying the Sr composition and, therefore, the transition from semiconductor metal (superconductor) is observed.

09717/09599

**IR Study of  $Ba_{3-x}Y_xCu_2O_7$  High Temperature Superconducting Materials**  
40090045f Beijing DIWEN WULI XUEBAO  
[CHINESE JOURNAL OF LOW TEMPERATURE  
PHYSICS] in Chinese Vol 9 No 4, Dec 87 pp 276-278

[English abstract of article by Hu Keliang [5170 0340 5328], et al., of the Center of Structure and Element Analysis, Department of Physics, University of Science and Technology of China, Hefei]

[Text] Infrared spectra of the  $Ba_{3-x}Y_xCu_2O_7$  ( $0.6$  less than or equal to  $x$  less than or equal to  $2.7$ ) series materials have been studied. The results show that the

absorption spectra of samples change with the  $x$  values. The peaks of the spectra are related to the vibrations of Y-O, Ba-O, and Cu-O bonds, respectively.

The structure of the materials is discussed based on the results of IR analysis. The suggestion of two different structures in the series is confirmed by means of the spectrum treatment and is in agreement with the results of X-ray analysis of the samples.

09717/09599

### **Superconductivity, Structure of Ag-Doped Ba-Y-Cu-O Superconductor**

40090045g Beijing DIWEN WULI XUEBAO  
[CHINESE JOURNAL OF LOW TEMPERATURE  
PHYSICS] in Chinese Vol 9 No 4, Dec 87 pp 279-280

[English abstract of article by Cai Weili [5591 4850 3810], et al., of the Department of Physics, University of Science and Technology of China, Hefei]

[Text] Partial substitution of Ag for Cu has been made in the Ba-Y-Cu-O superconductor. The results of electrical measurement of  $\text{Ba}_{1.2}\text{Y}_{1.8}\text{Cu}_{1.8}\text{Ag}_{0.2}\text{O}_{7-y}$  show that the zero resistivity temperature of the material is 90K. The X-ray diffraction pattern and the Raman spectrum of the sample indicate that neither a new phase appears nor the original structure is destroyed when adding a small amount of silver ion material.

09717/09599

### **YBaCuO Superconductors With Transition Width of 1K**

40090045h Beijing DIWEN WULI XUEBAO  
[CHINESE JOURNAL OF LOW TEMPERATURE  
PHYSICS] in Chinese Vol 9 No 4, Dec 87 pp 281-283

[English abstract of article by Ye Weijiang [0673 4850 3068], et al., of the Institute of Physics, Chinese Academy of Sciences, Beijing]

[Text]  $\text{Y}_x\text{Ba}_{1-x}\text{CuO}_{3-y}$  superconductors have been prepared with  $\text{Y}_2\text{O}_3$ ,  $\text{BaO}_2$  and Cu powder. The resistance and ac magnetic susceptibility methods have been used to measure the superconducting properties of the samples. The onset and zero-resistance temperatures and transition width of samples with  $x = 1/3$  are 97K, 93K, and 1K, respectively. The same measurements of samples with  $x = 0.6$  are 95K, 90.5K, and 1K, respectively. The relationship between the critical current and temperature has been measured using the persistent current method.

09717/09599

### **Study of Superconductor in Y-Ba-Cu-O by TEM**

40090045i Beijing DIWEN WULI XUEBAO  
[CHINESE JOURNAL OF LOW TEMPERATURE  
PHYSICS] in Chinese Vol 9 No 4, Dec 87 pp 284-288

[English abstract of article by Fan Hanjie [2868 3352 4634], et al., of the Institute of Physics, Chinese Academy of Sciences, Beijing]

[Text] Recently, high  $T_c$  superconductors have been discovered in some rare-earth La-Ba-Cu-O and Y-Ba-Cu-O systems. The crystal structure and defect of the superconductor in the Y(La)-Ba-Cu-O system have been studied by selected area electron diffraction, high resolution electron microscopy and micro-area x-ray energy dispersive analysis. There are two kinds of oxides in Y-Ba-Cu-O compounds. One of them is an orthorhombic phase with  $a = 0.712$  nm,  $b = 1.22$  nm, and  $c = 0.556$  nm. The ratio of yttrium to barium atoms is 2:1. Another is a superconducting oxide with a distorted perovskite structure. The ratio of yttrium to barium atoms in this material is 1:2. A triple superlattice period along the  $c$  axis,  $c = 3a$ , has been observed. The contrast change in the corresponding lattice image implies a discontinuous structure variation caused by the order-disorder transition of Y and Ba atoms. The high resolution electron microscopic image of a superconducting phase in the Y-Ba-Cu-O system has been obtained. It is possible that the oxygen vacancy exists in the Y-Y plane nets. There are many 90 degree microdomains, from tens to hundreds of angstroms, in the La-Ba-Cu-O system superconductor with  $T_c = 15$ K. These might influence the superconductivity.

09717/09599

### **Superconductivity of Sr-Y-Cu-O Systems**

40090045j Beijing DIWEN WULI XUEBAO  
[CHINESE JOURNAL OF LOW TEMPERATURE  
PHYSICS] in Chinese Vol 9 No 4, Dec 87 pp 296-298

[English abstract of article by Zhang Han [1728 6799], et al., of the University of Science and Technology of China, Hefei]

[Text] Samples with nominal compositions of  $\text{Sr}_x\text{Y}_{1-x}\text{CuO}_3$  (0.050 less than  $x$  less than 0.550) were prepared. The temperature dependence of resistance was measured. The highest transition temperature was observed in  $\text{Sr}_{0.4}\text{Y}_{0.6}\text{CuO}_3$ , which has  $T_c(\text{onset}) = 100$ K,  $T_c(\text{mid}) = 93$ K and  $T_c(\text{gr}=0) = 91$ K. The relationships between superconductivity and composition, as well as sintering temperatures, were studied in detail. It was observed that the transition temperature  $T_c$  of the superconductor increases from  $T_c(\text{gr}=0) = 70.5$ K ( $x = 0.150$ ) to  $T_c(\text{gr}=0) = 91$ K ( $x = 0.400$ ) with  $x$  values, then decreases to  $T_c(\text{gr}=0) = 74$ K at  $x = 0.500$  under the same sintering conditions. The experimental results show that the sintering temperature dramatically affects the superconductivity in the system.

09717/09599



**Exciton-Like Model for Far-Infrared Absorption Spectra in  $Y_xBa_{3-x}Cu_2O_7$  High  $T_c$  Superconductors**

40090045k Beijing DIWEN WULI XUEBAO  
[CHINESE JOURNAL OF LOW TEMPERATURE PHYSICS] in Chinese Vol 9 No 4, Dec 87 pp 299-302

[English abstract of article by Wang Guanzhong [3769 0385 0022], et al., of the Department of Physics, University of Science and Technology of China, Hefei]

[Text] In this paper, the authors use an exciton-like model to account for the origin of the far-infrared absorption lines in  $Y_xBa_{3-x}Cu_2O_7$  systems. The far-infrared absorption lines in these materials can be assigned to transitions from three series of lines in an exciton energy level diagram. The results of calculated and measured data are listed in a table, in which the good agreement between theoretical and experimental values indicates that the model is acceptable and the far-infrared absorption lines observed might have origins in something other than phonons. The multi-line series assumption might be due to the multi-phase structure of the materials and, therefore, single phase structures might produce single line series transitions. A figure shows that the major difference between normal and superconducting samples is the increase in intensities of peaks at  $205\text{ cm}^{-1}$  and  $237\text{ cm}^{-1}$  from the former to the latter. In the normal sample there are two lines at  $200$  and  $230\text{ cm}^{-1}$ , with lines at  $323$ ,  $400$ , and  $447\text{ cm}^{-1}$  broadening, and about a  $4\text{--}8\text{ cm}^{-1}$  shift toward high wavelengths when compared to the superconductors. As for the unobserved phonon absorption lines in the far infrared region, they might be due to the thin powder samples and, therefore, the phonon absorption might be much weaker than that of excitons or the superposition of phonon absorption on the exciton lines. Therefore, the superconducting mechanism in  $Y_xBa_{3-x}Cu_2O_7$  systems might depend on the resonance coupling through the phonon and exciton transitions.

09717/09599

**Research and Development of Stable High Field Nb-Ti Superconducting Magnets**

40090045l Beijing DIWEN WULI XUEBAO  
[CHINESE JOURNAL OF LOW TEMPERATURE PHYSICS] in Chinese Vol 9 No 4, Dec 87 pp 316-324

[English abstract of article by Jiao Zhengkuan [3542 2973 1401], et al., of the Institute of Plasma Physics, Chinese Academy of Sciences, Hefei]

[Text] The disturbance spectrum of an adiabatic superconducting magnet and know-how of winding a magnet are discussed. The authors have wound six magnets with domestically-produced Nb-Ti multifilamental wire, using a new method developed at their institute. The highlights of the method lie in the brushing wax adding  $Al_2O_3$  with high heat conductivity and/or  $Gd_2O_3$  powders with high heat capacity at low temperatures. The

centric fields produced by these magnets are all higher than  $8.5\text{ T}$ , with one of them having set a domestic record of  $9.24\text{ T}$ . All the quench current have exceeded 95 percent of the  $I_c$  of short samples on load lines, without any training behavior.

09717/09599

**Theoretical Model for Transverse Flow Pin-To-Plate Discharge  $CO_2$  Lasers**

40090043a Shanghai ZHONGGUO JIGUANG  
[CHINESE JOURNAL OF LASERS] in Chinese Vol 14 No 12, 20 Dec 87 pp 705-709

[English abstract of article by Xia Zuyong [1115 4371 0516], et al., of the Institute of Lasers, Huazhong University of Science and Technology, Wuhan]

[Text] A theoretical model is proposed to calculate the working parameters of transverse flow pin-to-plate discharge  $CO_2$  lasers, taking into consideration the distribution of the electron density, electron and gas temperature, gas velocity, excitation and relaxation rates in the flowing direction. Calculations of the small signal gain and output power of MGL-84 lasers are made with the model, and the results calculated agree with those found with the experiment.

9717/9604

**Active-Passive Mode-Locked Laser Using Multi-Compound Doped YAG as Q-Switch**

40090043b Shanghai ZHONGGUO JIGUANG  
[CHINESE JOURNAL OF LASERS] in Chinese Vol 14 No 12, 20 Dec 87 pp 711-713, 717

[English abstract of article by Chen Youming [7115 2589 2494], et al., of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences; Gui Youxi [2710 1429 0823], et al., of North China Institute of Optics and Electronics Technology, Beijing]

[Text] A new crystal—multi-compound doped YAG—is used for active-passive mode-locking and Q-switching. For a C-axis Nd:YLF laser, the average energy of the pulse train is  $5.64\text{ mJ}$ , the energy fluctuation is less than  $\pm 5$  percent, with a probability of 96.9 percent, and the average pulse width is  $1.45\text{ ns}$ . When the Nd:YAG is used as the laser medium, the average energy of the pulse train is  $6.79\text{ mJ}$ , the fluctuation is less than  $\pm 4$  percent, with a probability of 96 percent, and an average pulse width (FWHM) is  $270\text{ ps}$ .

9717/9604



**Laser, Spectral Characteristics of DCM-Propylene Carbonate Dye Laser System Pumped by XeCl Excimer Laser**

40090043c Shanghai ZHONGGUO JIGUANG  
[CHINESE JOURNAL OF LASERS] in Chinese  
Vol 14 No 12, 20 Dec 87 pp 731-734

[English abstract of article by Shangguan Cheng [0006 1351 6134], et al., of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences; Liu Dianyou [0491 3013 0645], et al., of the Institute of Chemistry, Chinese Academy of Sciences, Beijing]

[Text] The energy output and spectral characteristics of a DCM-propylene carbonate dye laser system pumped by an XeCl excimer laser have been measured. The results obtained indicate that the DCM-propylene carbonate dye laser system shows a lower energy output and width frequency-tuning range than when dimethylsulfoxide is used as the solvent, which is expected from a comparison of the fluorescence parameters of DCM in both solvents.

9717/9604

**Microcomputer System Undergoes Evaluation**

40080051b Beijing JISUANJI SHIJIE in Chinese,  
23 Dec 87, p 2

[Summary] The Langchao ["Wave" or "Tide"] microcomputer system, developed and produced by the Shandong Electronic Equipment Factory (the Shandong Computer Service Company), underwent evaluation in Jinan a few days ago. Employing a large panel structure, gate array technology, and domestic and foreign Chinese-character processing technology, this computer is designed as a high-level Chinese character and graphics display system. Its software configuration includes Chinese-style DOS and a Chinese-English-compatible, multiuser, multitask, time-sharing C-XENIX operating system.

With a larger internal storage and higher execute speed, it is compatible with the PC/AT. Chinese transformation of the master console and printer drive module is realized in an original way, and the upward-compatible 0520 multiple-order system software and applications software represent a major advance in the campaign for domestic production.

These adaptations have brought this computer to a functional level on a par with the advanced standards of similar-order models.

/12913

**Jilin University Develops Cambridge Ring System Prototype**

40080051a Beijing JISUANJI SHIJIE in Chinese, 23 Dec 87, p 2

[Summary] The debugging of the prototype of China's first independently developed Cambridge Ring System has been completed by Jilin University's Computer Department. This system is based on the ring-structure, high-speed digital-communications local area network (LAN) developed at Cambridge University in 1976-78 and standardized by ISO.

Jilin's program was begun in 1983 with documents furnished by Cambridge. In July 1986, an independently developed Cambridge-Ring LAN was used to construct the "Jilin Distributed Heterogeneous-Computer System" (JDACS). Its data transmission rate of 10 MB/s, maximum interstation range (maximum node spacing) of 200 m, and bit error rate of under  $10^{-11}$  have reached advanced standards.

Utilizing CAD plate making, the designers achieved time-slice dielectric addressing (ISO 802/7 standard). For the transmission dielectric standard, extremely common plastic-covered twisted pairs are used, greatly reducing cost. Signalling is via baseband transmission, and clock frequency is up to 10 MHz, using phase-locked-loop frequency stabilization and synchronization.

Communications software includes Basic Block Protocol (BBP), Single Slot Protocol (SSP), and Byte Stream Protocol (BSP), as well as Cambridge-Ring-to-Ethernet communications software and other batch network software. A system-stationary, interrupt-drive method is used: after the communication is completed, there is automatic return via interrupt. Moreover, dialogue and consultation communications are allowed. This software provides functions such as document transmission, keyboard dialogue, and a directory of the arbitrary query stations.

[Editor's note: There is a detailed description entitled "JDACS: A Distributed Computer System"—complete with diagrams and tables—on pp 1-10 of XIAOXING WEIXING JISUANJI XITONG (Mini-Micro Systems), Vol 8, No 9, Sep 87, if further information is desired.]

/12913

**Beijing Factory Imports Computer-Network Production Line Equipment**

40080051c Beijing JISUANJI SHIJIE in Chinese,  
23 Dec 87, p 10

[Summary] In order to raise production capability and quality, Beijing Computer Factory No 2 is carrying out technological renovation, including importing of equipment meeting advanced international standards of the Eighties. Check upon delivery has recently been completed for this critical equipment used in computer-network production lines.

Equipment imported includes: (1) shaping machines for precise cutting and shaping of basic components, semi-automatic machines for precision plugging of these components into circuit boards, circuit-board (wave) crest solderers operating in the 1.6-15-inch range, and deionized-water cleaning machines for circuit boards; (2) IC testers, pc-board and optical-board testers, on-line testers for assembled circuit boards, etc.; (3) logical-analysis instruments and multiuser general-purpose microcomputer development systems for multiple-machine software and hardware development; and (4) other equipment, tools, and jigs.

The distinctive feature of this production line is its universality: it can produce not only computer-network components but also other computer systems. In a trial from June of this year up to now, this production line has put out 145 Great Wall 0520 model B computers and over 100 GF 0520 computers.

Use of this equipment will greatly shorten the production cycle for all processes and raise efficiency many times over.

/12913

#### **Sichuan Factory Puts Out STD Bus Industrial-Control Computer Boards**

40080051d Beijing JISUANJI SHIJIE in Chinese, 23 Dec 87, p 14

[Summary] The Xinxing Instrument Factory in Chengdu, Sichuan, operated under the Ministry of Astronautics Industry, recently put out an STD Bus series of boards for use in various industrial-control general-purpose computers. Because of their standardization, functional modularization, universality, expandability, small size (each pc board is 16.5 x 11.4 cm), and flexible and convenient use, they have been favorably received by specialists and are now being marketed.

The most important products are: main-computer Z80A CPU boards, 18K and 32K memory expander boards, 18K and 32K static-memory RAM/EPROM expander boards, keyboard/display panels, 32-line TTL parallel I/O interface boards, 64-line TTL parallel input interface boards, 64-line TTL parallel output interface boards, Z-80 PIO/CTC control boards, 8-bit and 12-bit A-D/D-A converter boards, programming boards, combination racks, etc.

These boards are especially applicable to medium-to-small-scale industrial-control and signal-processing equipment and to detection instruments and meters for intelligent devices, and are relatively ideal for measuring and control equipment used in space physics, with its restricted and constantly changing requirements. These boards also have broad practical value in areas such as

machine-tool control, petroleum, metallurgy, chemistry, electronic metering, industrial communications, food, medicine and health, textiles, and environment-sensitive warehousing.

/12913

#### **More Powerful Marine Gas Turbine Developed**

40100007b Beijing XINHUA in English  
1030 GMT 14 Jan 88

[Text] Xi'an, Jan 14 (XINHUA)—Chinese scientists have just perfected a 13,000-horsepower marine gas turbine which will enable ships to travel 30 nautical miles an hour faster.

Today Ou Yingmin, chief engineer at the Xi'an Aircraft Engine Manufacturing Company, reported, the newly-developed gas generator, built jointly by his company and an institute affiliated with the China State Ship-building Corporation, just passed a 150-hour stress test.

According to Ou, the scientists spent seven years working on the turbine with the help of state of the art technology imported from a British company.

"China used to have to import these turbines to equip the Navy's ships," Ou said, "but now we will be able to manufacture 20 turbines annually and export some."

/06662

#### **New Camera Device May Aid Astronautics, Reactors**

40100007a Beijing XINHUA in English  
1629 GMT 17 Jan 88

[Text] Nanjing, January 17 (XINHUA)—A new device for picture taking and transmission has been developed by a research institute in Nanjing, capital of Jiangsu Province.

The new device, composed of a 400,000-fiber optical cable coupled with a camera, can monitor conditions in inaccessible places such as nuclear reactors and chemical reaction towers through high-resolution pictures.

Experts said the new device, the first of its kind in China, can be widely used in astronautics, aviation and other industries.

The device passed the state technical appraisal on January 16.

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**Nuclear Reactor Heat Exchanger Developed**  
*40100007c Beijing XINHUA in English*  
*1541 GMT 17 Jan 88*

[Text] Beijing, Jan 17 (XINHUA)—China has succeeded in developing a main heat exchanger used in low temperature, heat supplying nuclear reactors.

So far, four main heat exchangers have been jointly designed and manufactured by the Qinghua University and a boiler factory in Harbin, and two others will come out later this month.

Production of this energy converting device has paved the way for the construction of a 450,000-kilowatt nuclear heat-supplying station at Harbin, capital of northernmost China's Heilongjiang Province, and marked a new stage in China's peaceful use of nuclear energy.

An official at the factory said after the Soviet Union, China is the second country in the world in putting low temperature, heat supplying nuclear reactors into practical use.

/06662

**Oceanographic Engineering, Geological Survey of Beibu Wan Launched**

40081025b Beijing KEJI RIBAO [SCIENCE & TECHNOLOGY DAILY] in Chinese 15 Aug 87 p 1

[Report by correspondent Xiao Ning [1420 1380] and journalist Du Mingming [2629 2494 2494]: "Engineering Geological Survey and Assessment of a Northern South China Sea Establishes Foundation for Future Marine Engineering in China"]

[Text] What is the engineering geological situation of the WEI 11-1 sea area in the Beibu Gulf of the South China Sea? What kind of gravity type platform should China design and construct? These questions have been satisfactorily answered by more than 80 scientist-technicians from the Chinese Academy of Sciences and the State Seismological Bureau, who made concerted efforts during a 2-year survey and assessment. Recently, this achievement has won the national S&T Progress Prize, second class.

"Engineering Geological Assessment of the WEI 11-1 Area in the Beibu Gulf of the South China Sea" is a part of the "Feasibility Study on Concrete Platform Applications," a key state S&T project.

As everyone knows, all of the engineering installations for off-shore petroleum exploration and exploitation are established on the sea floor. In order to guarantee the safety of these structures and insure a reasonable cost, it is necessary to fully survey and assess the engineering, geological, and ground conditions on the ocean floor in order to provide essential data and materials for engineering design. At present, this kind of survey and assessment is a developing high technology in the world, but it is lacking in China.

The sponsors of the survey and assessment were Qian Shouyi [6929 1108 2496], professor at the Beijing Mechanics Institute, and Guo Jianyang [6753 6015 2254], research professor at the Wuhan Rock and Soil Institute, both under the Chinese Academy of Sciences. Under their leadership, there were more than 80 scientist-technicians from the Mechanics Institute, Rock & Soil Institute, South China Sea Oceanography Institute and Oceanography Institute, all belonging to the Chinese Academy of Sciences, and also the Engineering Mechanics Institute of the State Seismological Bureau.

Over the past 2 years, they were engaged in a broad and systematic integrated multi-disciplinary survey and in experiments which included oceanographic geology, engineering geology, soil texture science, soil mechanics, seismic engineering, etc. They clarified the topography, geomorphology, upper stratum structure, and stratum divisions of the sea floor. They expounded their physical, chemical, acoustical, dynamic, and static characteristics

for different strata. A full analysis of load-bearing capacity and deformation of the foundation for the gravity-type platform has been completed and a detailed analytical report prepared.

Experts consider that this research not only provides a reliable basis for the investigation of the possibility of applying concrete platforms for the WEI 11-1 sea area and for conceptual design, but also established a good foundation for further independent oceanographic engineering geology survey, analysis, and assessment in China.

13317/09599

**Qingdao Described as Leader in Oceanography**

40081025d Beijing RENMIN RIBAO [Overseas Edition] in Chinese 3 Oct 87 p 4

[Report by journalist Zhang Rongda [1728 2837 1129]: "Qingdao Oceanographic Research Intensifies Its Foreign Contacts"]

[Text] Qingdao, 1 Oct (XINHUA)—Reform and opening up have caused the Qingdao oceanographic research to expand its foreign contacts for the first time.

From 1979 to the present, foreign oceanographers and specialists have visited Qingdao more than 2,000 times and over 1,000 people were sent out to more than 10 countries and regions to participate in academic activities, reflecting the fact that oceanographic research at Qingdao has reached a broader and higher level.

Qingdao is one of the important cities of China in oceanographic research. Many achievements there have reached an advanced position in the world. Among these, for example, are research on marine algae classification and production, physical oceanography, and aquatic breeding. These advanced research achievements have attracted foreigners in the same specialties. Eight international conferences have been held in Qingdao to date: the International Academic Conference on Algae, the International Conference on Economic Algae Classification for the Pacific, the International Conference on Sea Level Change and Its Application, and the International Conference on Physical Oceanography of Shallow Seas.

In May and June of this year, the International Conference on Commodity Algae Production and Utilization was held in Qingdao and Hainan Island. Scholars from over 20 countries and regions of the Third World joined the meeting.

China has made an effort to encourage Third World countries who have algae resources to develop their own algae research and utilization. Specialists and scholars who participated in the conference all highly appreciated this effort.

In addition to academic exchange, various oceanographic research institutions in Qingdao also conducted over 20 integrated oceanographic survey and research projects, and cooperated with foreign countries to achieve great progress. The South Yellow Sea Circulation and Deposit Dynamics Project was jointly conducted by the Oceanography Institute, Chinese Academy of Sciences, and the Woods Hole Oceanographic Institute of the United States. The ocean survey lasted 4 years. "Science No 1," the "Washington," and two other ships were sent out by both sides. This project has completed large-scale basic tasks for clarifying the environment of the South China Sea and exploiting marine organisms and petroleum resources.

Through different kinds of external contact, Qingdao has improved its laboratory facilities. It has accumulated

funds via various channels, and imported over 300 pieces of equipment and installations. Reform and the open policy have brought vitality to Qingdao's oceanography research.

At present, Qingdao has established an advanced physical oceanography laboratory, a microalgae laboratory, a marine biological specimen room, a computer center, and a test and experiment center, and provided over 20 big and medium-sized survey ships and marine survey aircraft. It has thus established a solid foundation for the advance of its marine research to a higher level.

13317/09599

**Application of Biological Techniques To Develop Energy, Control Pollution Emphasized**

40081026d Shanghai JIEFANG RIBAO in Chinese  
10 Aug 87 p 1

[Article: "Using Biotechnology To Develop Energy Resources and Control Pollution—The Institute of Biology at Jiaotong University Selects Problems for Key Attacks on Solutions in China—International Attention Is Being Focused On Practice in Ecological Research at Dongfeng State Farm, Urban Waste Water Treatment and Other Topics"]

[Text] The Institute of Biotechnology at Shanghai Jiaotong University has relied on international cooperation to use biotechnology for comprehensive solutions to problems demanding urgent solution in China like resource and energy shortages, environmental pollution and so on, and it has developed rather advanced qualities and skills. Chinese and foreign experts considered the intermediate test which passed evaluations on 18 September 1987 to be the first successful use of photosynthetic bacteria to treat waste water with high concentrations of citric acid both in China and in foreign countries and that it had attained advanced levels.

Since its establishment four years ago, the Jiaotong University Institute of Biology has continued to focus on problems which demand urgent solutions during economic construction. They have focused on society for survey research on "ecological farm research and practice" for breakthroughs in bioenergy (methane) exploitation and utilization, "using photosynthetic bacteria to treat water with high concentrations of waste organic matter" in cities and other projects to control "odor and filth."

State farms are experiencing coal shortages, their firewood sources are gradually shrinking and there is serious pollution from poultry and livestock manure. The Jiaotong University Institute of Biology first applied biotechnology and ecosystem engineering concepts for experimental research on a large-scale centralized methane supply system project at Shanghai's Dongfeng State Farm. They designed a set of high-efficiency technological processes in the "JDF high-efficiency energy supply from methane fermentation facilities" which have achieved year-round high-efficiency gas production. Since its completion in 1983, clean and convenient methane has been supplied on a continuous basis year-round to nearly 1,000 employee families. Dongfeng state farm is treating pollution by manure from its 750 dairy cattle and it has provided a household energy source for state farm employees and saved more than 700 tons of raw coal for the state farm each year. Moreover, the dregs left after methane fermentation can serve as a highly effective non-toxic feed. Achievements in this project now are being extended for application in all state farms in China. They also have been presented to UNESCO's "Man and the Biosphere" Commission and have served as a window and demonstration point for

international cooperation with foreign countries. The Institute of Biology has signed cooperative research agreements with relevant research institutes, companies and universities in Japan, the Federal Republic of Germany and Australia in the fields of ecosystems and organic agriculture research.

Water with high concentrations of organic wastes have become a primary source of water pollution and are a key problem in the field of environmental protection which urgently requires a solution. After choosing to focus its work on photosynthetic bacteria technologies, the Institute of Biology at Jiaotong University has made path-breaking progress through cooperation and exchanges with Mr Masayasu Kobayashi, a Japanese expert on photosynthetic bacteria applications research. They now are able to reduce the chemical consumed oxygen content in water with high concentrations of organic wastes from manure, fibers, hides and organic chemical industries from 10,000 to 20,000 mg/l to a few hundred mg/l, a removal rate of more than 95 percent.

12539/12223

**Focusing Resources To Control Red Tides Urged**

40081026c Beijing RENMIN RIBAO in Chinese  
19 Sep 87 p 3

[Article: "The State Oceanography Bureau Urges Attention to Ocean Pollution—Red Tides Have Occurred Recently In China's Seas"]

[Text] Red tides have been appearing in some of China's seas since 1986 and pose dangers to marine biological resources and the ecological environment. The State Oceanography Bureau recently urged that relevant areas address this issue and move quickly to control the trend toward an increasing frequency of red tide occurrence.

Red tides are changes in water color caused by an explosive proliferation of suspended marine organisms. Excessive proliferation of these suspended organisms rapidly consumes dissolved oxygen in the seawater and creates an oxygen-poor environment which injures or even kills aquatic organisms living in such waters. The color of the water in regions where red tides occur can become red, yellow, green, brown or black depending on the type of suspended organism. From 1986 to now, State Oceanography Bureau oceanic observation vessels and aircraft have discovered red tides in the ocean south of the Danshan Archipelago, near Baozhu Island in the west harbor of Xiamen and out to sea from the mouth of the Chang Jiang. Two red tides occurred out to sea from the mouth of the Chang Jiang alone between June and August of 1987 and at times were spread over an area more than 20 nautical miles long and six to seven nautical miles wide.



According to the presentation, there are written records of three occurrences of red tides before the 1970's and more than ten after the 1970's. They have become a key monitoring target for ocean monitoring personnel in the State Oceanography Bureau.

The reasons for formation of red tides are determined by many factors but there is no doubt that they are related to ocean pollution. Prevention of red tides has become a major issue facing the world's marine environment. The relevant responsible person in the State Oceanography Bureau feels that the first thing that should be done is a major effort to reinforce legal education on protecting the ocean environment so that the masses understand that protection of the ocean is a major issue of concern to the national economy and people's livelihood as well as creating wealth for future generations. Second, management should be reinforced to strictly prohibit discharge of oil and polluted water into the ocean along coastal areas and out to sea. During the first half of 1987 alone, ocean monitoring personnel discovered more than ten cases of oil and polluted water discharges by ships and oil drilling platforms in violation of regulations. This responsible person specifically referred to the poor concepts of legality in some ship disassembly plants and sites where the only concern is economic benefits. The coastal sea environment and the aquatic breeding industry will be severely affected if they cause additional pollution accidents. He urged that relevant departments establish strict application and approval systems for ship disassembly in the future and that those without facilities for preventing pollution not be built.

12539/12223

#### **Experts Forecast Severe Water Pollution by Year 2000**

40081026a Beijing *PEOPLE'S DAILY (OVERSEAS EDITION)* in Chinese 11 Sep 87 p 1

[Article: "Chinese Experts Forecast the Water Environment in the Year 2000—Total Polluted Water in Industry and Urban Areas Will Reach 800 Billion M<sup>3</sup> and Cause Enormous Economic Losses If Effective Steps Are Not Taken"]

[Text] The key scientific research project "Research on Forecasts and Countermeasures for the Water Environment in China in the Year 2000" carried out by 32 units including the Chinese Academy of Environmental Sciences was approved by experts on 10 September 1987. This was the most comprehensive, systematic and complete S&T achievement to date in China in the area of water environment for forecasting.

More than 400 scientific researchers from throughout China participated in the research project. They spent more than two years making forecasts of total polluted

water in China, polluted water discharges in 20 provinces, autonomous regions and municipalities and 57 cities, as well as the water environment in seven major rivers, 18 major lakes and along shore areas. They also proposed countermeasures.

The scientific researchers completed research summaries totaling more than 400,000 characters. Their prediction is that the total amount of polluted water in China in the year 2000 will be 80 billion m<sup>3</sup>, including 60 billion m<sup>3</sup> of industrial waste water and 20 billion m<sup>3</sup> of city household polluted water. Total water intake forecasts are 630 billion m<sup>3</sup>, of which 510 billion m<sup>3</sup> or 80 percent of total water use is for agricultural water use.

The report pointed out that the key to solving China's water resource crisis is to change traditional farm irrigation practices by adopting spray irrigation and drip irrigation technologies to reduce agricultural water utilization.

The scientific researchers felt that we should begin now to make an appropriate shift of focus in renovation of the water environment to medium and small cities, prepare good long-term environmental plans, be concerned with rational deployments of industry, improve production technologies, develop low-pollution production technologies, prevent latent pollution created during the modernization process and build waste water treatment plants in large cities.

The scientific researchers indicated that a failure to take effective measures to control pollutant discharges will cause direct losses of 273.5 billion yuan over the next 15 years in China because of pollution of the water environment.

12539/12223

#### **Cleaner Air Predicted; Pollution From Coal Burning Still a Problem**

40081026b Beijing *PEOPLE'S DAILY (OVERSEAS EDITION)* in Chinese 6 Oct 87 p 8

[Article by Wang Hanchen [3769 3352 5256]: "China's Air Is Becoming Cleaner"]

[Text] The 22nd Session of the Standing Committee of the Sixth National People's Congress has passed the "PRC Air Pollution Prevention Law." This is a major event in improving environmental quality in China and advancing the four modernizations drive. Many European developed nations and the United States began some time ago to use legal means to protect the atmospheric environment, a decade or more before China. The extent of air pollution in China now is only comparable to the development nations of the world during the 1950's and 1960's.

According to a survey of 60 Chinese cities, average daily concentrations of suspended particulates exceed national grade-2 standards ( $300 \text{ gm mg/m}^3$ ) by a factor of 2.2 (coal burned for heat during the winter and other reasons cause the standards to be exceeded much more in northern cities than in southern cities). Relevant departments estimate that air pollution causes total losses of several billion yuan each year in China, and rates of sickness and death related to air pollution are rising. Severe air pollution has forced all areas to strengthen leadership over air pollution control and encouraged development of pollution prevention. Monitoring data indicate a universal reduction in precipitates from former levels. Precipitates in Beijing during the Sixth 5-Year Plan were down 27 percent from the Fifth 5-Year Plan. They dropped by 22.7 percent in Shanghai, 22.1 percent in Luoyang and 54.7 percent in Tangshan. Moreover, monitoring in 50 cities across China indicates that 19 are seeing a trend toward declining suspended atmospheric particulates from former levels, while 22 were holding steady and nine had increased.  $\text{SO}_2$  concentrations during the heating season in northern cities and in southern cities which burn high-sulphur coal are up. Coal's dominance of China's energy resource structure today means that particulates from burning coal account for 73 percent of the 23 million tons of particulates discharged in China each year. Coal is the source of 90 percent of the 14.6 billion tons of  $\text{SO}_2$  China discharges each year. This has led to popularization of shaped coal through China (honeycomb briquets, coal balls and so on which pollute less than loose coal and conserve energy). According to statistics, shaped coal output in China doubled between 1980 and 1985, and has reduced air pollution from coal. Coal's dominance of China's energy resource structure will persist, and the four modernizations drive and development of township and town enterprises will increase absolute demand for coal, so improvement of environmental quality will continue to be extremely difficult.

12539/12223

#### **Acid Rain Causing Extensive Damage To Southwest Pine Forests**

40081027 Beijing KEJI RIBAO in Chinese  
16 Sep 87 p 2

[Summary] A survey conducted by an acid rain study team composed of scientists from 19 national science associations has found that acid rain has caused extensive damage to forests in Southwest China, especially in Sichuan Province.

Acid rain contains mainly sulfur dioxide and nitrogen oxides. Generally, rainfall with a pH value of less than 5.6 is called acid rain. Acid rain affects plants as well as humans, buildings and vehicles. It washes away the forest soil, depriving the trees of nutrition, and activates

aluminum ions which then poisons the plants' root systems. Also, acid rain and acid fog cause slow growth rates, lower plants' resistance to insect attack, and eventually kill the plants.

The team discovered that acid rain occurs mainly South of the Chang Jiang, with low pH value and high frequency. The survey showed that the annual average pH value in the Chongqing-Guiyang, the worst area, is 4 in the urban centers, and 4.5 in the suburbs and surrounding countryside. In Sichuan and Guizhou provinces, most of the annual precipitation is acid rain. Other acid rain areas include the Guangxi Autonomous Region, Zhejiang and Hunan provinces and Shanghai, all in south China. In China, acid rain is generally thought to be closely related to industrialization, topography, weather, and poor-quality fuel, and is easily formed in basin and valley areas where there is little wind such as the Sichuan Basin. In both Sichuan and Guizhou, the sulfur content of coal—China's main fuel—is higher than in other regions. Because of less windy, the accumulated  $\text{SO}_2$  in the air cannot spread to other regions. Therefore, acid rain is formed primarily by local pollution in urban areas. Evidence of serious acid rain damage south of the Chang Jiang was found in 1982 in Chongqing, Sichuan, where a 27,000-mu pine forest was reduced by more than half by July 1983 by what the scientists thought was a combination of acid rain and acid fog. The Maocaoba pine forest in Sichuan's Fengjie County used to cover a 90,000-mu mountain area, but now 90 percent of the trees have died. Scientists believe that several factors have contributed to the death of these trees. A rich sulfur mine is located in the Maocaoba forest and sulfur processing plants have been set up by the county, villages, and even individuals. Because of poor management, backward technology and poor equipment at the plants, a lot of sulfur dioxide is emitted during the processing, causing acid rain. No living grass can be seen for about 1 square kilometer around the plants.

The study team points out that the acid rain problem threatens even more serious damage to local forest areas. If greater effort is not taken the problem will seriously hamper economic development in the Southwest areas.

08309

#### **Gansu Makes Gains Against Pollution** 40101002 Beijing CHINA DAILY in English 2 Oct 87 p 3

[Excerpts] Gansu Province in northwest China was once notorious for its pollution. But it has effectively checked the deterioration of its environment and greatly improved air quality since pioneering a protection contract responsibility system.

But the sayings no longer apply after years of effort to control pollution, and especially after the institution of the contract system in the past two years, conditions have greatly improved, Zhang said.

In Lanzhou, sulphur dioxide and the density of soot particles in the air dropped 41 per cent and 20 per cent respectively from 1986 to 1987. Pollution caused by such by-products of big industries such as tungsten, lead, chlorine and petrochemicals have been controlled, Zhang said.

Out of 300,000 households in Lanzhou, 80,000 now use liquid gas for cooking and another 10,000 use electricity, greatly reducing smoke. And there has been no further pollution of the Yellow River which runs through Lanzhou.

Efforts to plant trees and grass have brought favourable changes to the climate of the area and have increased rainfall, Zhang said.

At the beginning of this year, Gansu was urged to share its experience with other provinces.

/06091

#### **Ministry Acts to Control Pollution From Power Stations**

40101002a Beijing *CHINA DAILY in English*  
29 Dec 87 p 3

[By Tang Xiaoqing and Xie Songxin]

[Excerpts] Large and medium-sized thermal power stations should stop discharging waste into rivers, lakes and seas within the next three years, according to the Ministry of Water Resources and Electric Power.

Vice-Minister Zhang Fengxiang asked electricity administrative bureaux around the country to stop 17 power stations from discharging coal ash and dregs into the country's water systems by 1990 as a first step to control the growing pollution problem. These stations discharged 42 million tons of waste in 1986.

Zhang also ordered the industry to make use of 14 million tons of coal ash every year, 23 percent of the annual discharge, compared with 20 percent at present. Farmland now piled with waste would be returned to farming by 1990.

He said China should make greater efforts to use waste instead of storing it.

Commission statistics show that China's thermal power stations are discharging an extra 5 million tons of coal ash and dregs every year as generating capacity increases.

This year, more than 50 million tons of waste is expected to be drained, compared with 45 million tons in 1986. The figure is expected to be doubled by the turn of the century.

At present, 80,000 hectares of farmland are piled with 7.5 billion tons of industrial dregs, causing a huge amount of waste.

0684/12913

**Preparation of  $\lambda$ [ $^3\text{H}$ ]DNA and Assay of Contaminated Exonucleases in Enzyme Preparations"**

40081006a Beijing SHENGWUHUAXUE YU  
SHENGWUWULI JINGZHAN [PROGRESS IN  
BIOCHEMISTRY AND BIOPHYSICS] in Chinese  
No 1 Feb 87 pp 45-47

[Article by Liu Youguo [0491 0147 0948], Liu Zhongchang [0491 0022 2490] and Song Guiyun [1345 2710 0061]: "Preparation of  $\lambda$ [ $^3\text{H}$ ]DNA and the Assay of Contaminated Exonucleases in Enzyme Preparations"]

[Text] Abstract: This article briefly explains a convenient way to prepare  $\lambda$ [ $^3\text{H}$ ]DNA. By using this method to prepare  $\lambda$ [ $^3\text{H}$ ]DNA, more than 10 mg of product can be obtained per liter of culture. This is more than 99 percent more than the radioactive  $6.75 \times 10^4$  cpm/ $\mu\text{g}$  $\lambda$ DNA acid-insoluble radioactive product. Use of single chain and natural  $\lambda$ [ $^3\text{H}$ ]DNA as a substrate makes possible the easy assay of minute quantities of exonuclease I, II, and III contaminant activity in enzyme preparations.

In genetic engineering, transformation of the gene carrier DNA frequently gets help from tool enzymes such as the restriction enzymes endonuclease and DNA-modifying nuclease. These zymins should be as free as possible of non-specific endonuclease and exonucleases contaminants. This article makes reference to the methods of Maniatis and Kathleen et al [1,2], and revises them somewhat. It uses the substrate from already prepared  $\lambda$ [ $^3\text{H}$ ]DNA to assay minute quantities of exonuclease contaminant activity in enzyme preparations.

**Preparation of  $\lambda$ [ $^3\text{H}$ ]DNA**

**1. Reagents**

a. Use double distilled phenol, 0.1 M Tris-HCl at a pH of 8.0, and 0.2 percent 2-mercaptoethanol that is saturated. Keep ready for use at 4 degrees centigrade. b. Chloroform for a mixture of double distilled chloroform and isoamyl alcohol (V:V being 24:1). c. Ethyl ether, using double distilled water to saturate. d. [Methyl group- $^3\text{H}$ ] thymus gland pyrimidine nucleoside, 27 Ci/mmole, a product of the Shanghai Atomic Energy Institute. e. Scintillation liquid: xylene scintillation liquid (1,000 ml xylene, 14 g ppo, and 50 mg popop), dioxane scintillation liquid (1,000ml dioxane, 80 g naphthalene, 4 g ppo, and 20 mg popop). f. Deoxyadenosine and other reagents of Chinese manufacture.

**2. Composition of Thallus Culture and  $\lambda$ [ $^3\text{H}$ ]DNA**

a. Thallus Culture. Use  $\lambda$ c1857ts Sam 7 bacteria to inoculate an LB culture plate. Keep at 30 degrees centigrade overnight. Inoculate two LB culture plates from the same bacteria colony spots, then keep them overnight at 30 degrees centigrade and 42 degrees centigrade respectively. Select for use as bacteria species only those

colonies of bacteria that grew at 30 degrees centigrade but did not grow at 42 degrees centigrade, using them to inoculate two 5,000 ml triangular flasks to each of which has been added 500 ml of LB culture liquid at 30 degrees centigrade. Shake vigorously. When the cells grow to an O.D<sub>600</sub> value in between 0.5 to 0.6 of an hour, raise the temperature of the culture quickly to 45 degrees centigrade and keep it there for 30 minutes for heat induction. Examine inductance results after 20 minutes. Put 1 ml of culture in each of two test tubes. To the first test tube, add 1 or 2 drops of chloroform. Add no chloroform to the second, which will serve as a control. Maintain temperature at 37 degrees centigrade for 5 to 10 minutes. Shake the test tubes intermittently and compare them under light to see whether the culture to which the chloroform has been added goes into solution and looks semi-transparent. If, at the same time, the control test tube appears murky, this shows the culturing has been successful, and the experiment can continue. Lack of a clear distinction between the two test tubes shows the culturing has not been successful, and will have to be repeated.

2. Composition of  $\lambda$ [ $^3\text{H}$ ]DNA. After heat induction has been completed, immediately add the following to the flask: 5 mCi of  $^3\text{H}$  deoxythymus gland pyrimidine nucleoside ( $^3\text{H}$ -dT, 7 Ci/mmole, 10  $\mu\text{Ci/ml}$ ) and 3.6 ml deoxydadenosine dA, 0.1 mg/ml). To another flask, add the above components for later use. Shake vigorously at 37 degrees C for 3 to 6 hours to permit great propagation of bacteriophages, and a halt to the growth of host cells. Combine  $^3\text{H}$ -dT and dA with the newly formed  $\lambda$  DNA to produce  $\lambda$ [ $^3\text{H}$ ]DNA. Centrifuge at 4,000 rpm at 4 degrees C to collect the thalli. At the same time, take 5 ml of culture from the control flask and add 0.5 ml of chloroform to it. Shake to break the cell walls. Centrifuge to bring the serum to the top, and use a 1.1128 strain of Escherichia to check the thallus titer of the bacteria test lambda bacteriophages. In general, they should amount to  $2 \times 10^{10}$  bacteriophages per ml of culture.

**3. Extraction and Purification of Bacteriophages**

a. Draw off the crude extract and suspend the cells obtained from centrifuging in 30 ml of TM solution (to 50 mM Tris-HCl, pH 7.6, 10 mM  $\text{MgCl}_2$ ). Then add 10 percent chloroform (V/V), and shake vigorously so the cell walls rupture. Next, add 1 mg each of DNase1 and RNase. Maintain at 37 degrees centigrade for 2 hours to degrade the host cell nucleic acid. Centrifuge for 10 minutes at 4 degrees centigrade and at 10,000 rpm to remove the cell fragments. Then decant the serum from the top and add NaCl to bring the final viscosity to 1 M. Next, mix in polyethylene glycol 6,000 to bring the final viscosity to 10 percent (W/V). After the polyethylene glycol has completely dissolved, set aside at 4 degrees centigrade for 2 hours to allow the bacteriophages to settle entirely. Then centrifuge the 4 degree centigrade liquid at 11,000 rpm for 20 minutes. Discard the clear

liquid at the top and pour off the polyethylene glycol that is remaining in the centrifuge tube. Suspend the sediment in 20 ml of TM to obtain a crude extract of bacteriophages.

b. Simple way to get rid of protein. Dilute the crude extract of bacteriophages in the TM solution to the point where the  $O.D_{260}$  value is approximately 65. Add an equal volume of chloroform and extract for 30 seconds; centrifuge to get the aqueous phase and purify further.

c. Glycerine gradient centrifuging. Use an ultraspeed Hitachi centrifuge fitted with a 10.5 ml centrifuging tube for gradient density centrifuging. First place 4 ml of TM solution containing 40 percent glycerine in the bottom of the tube, then put 3 ml of a 5 percent glycerine TM solution on top of it, and finally add 3 ml of the bacteriophage solution as a top layer. Centrifuge the 4 degrees centigrade mixture at 110,000 g [sic] for 60 to 90 minutes. The bacteriophages will settle to the bottom of the tube and appear as transparent bright spots. Discard the clear fluid at the top, and get rid of the excess fluid in the tube so as to prevent the host cell's nucleic acid and the degraded material from contaminating the final product. To each tube, add between 0.5 and 1 ml of TM solution and let stand overnight at 4 degrees centigrade. Use a wide mouthed titration tube to spread the bacteriophages fully. Following glycerine gradient centrifuging, purified  $\lambda$  bacteriophages are available.

#### 4. Extracting $\lambda$ DNA

Dilute the purified bacteriophages in a TM solution to 10  $O.D_{260}$  per ml. Then add an equal volume of phenol to extract for 20 minutes. Centrifuge at 4,000 rpm for 5 minutes and retain the top layer aqueous phase. Then add an equal volume of phenol and chloroform (in a ratio of 1:1), the chloroform acting in turn to extract the aqueous phase. Then use ethyl ether to extract the aqueous phase two or three times. The aqueous phase remaining following extraction is a  $\lambda$  DNA solution. Perform a dialysis on a solution of 10 mM of Tris-HCl at pH 8.0, and 1 mM of EDTA at a volume that is 1,000 times again as great as that of the  $\lambda$  DNA solution; change the dialysis exterior fluid, and take a 30 microliter sample from the dialysis external fluid every 4 hours and add it to the dioxane scintillating fluid to test the cpm. When the cpm goes down to 100, halt dialysis. Test the DNA solution's  $O.D_{260}$  absorption value and figure the DNA's yield rate. After adding the aforementioned buffering solution of 50 percent glycerin to the DNA solution to dialyze and concentrate it, it was transferred to a sterilized container and maintained at 4 degrees centigrade for more than 3 years with no degrading of the DNA taking place.

#### Results and Discussion

##### 1. Simple Method That Produces a High DNA Yield Rate

The aforesaid method for preparing  $\lambda$  DNA is simple and easy to do. It avoids long ultra high speed centrifuging and the waste of expensive palladium chloride. References report that the use of other preparation methods produced yields ranging from 0.6 to 0.8 mg [3], between 1 and 2 mg [4], and 5 mg [2] per 1,000 ml of culture. We derived approximately 6 mg of  $\lambda$ [ $^3$ H]DNA from 500 ml of culture, and the yield rate of more than 5 mg in repeat experiments was higher than the aforesaid yield rates.

##### 2. Determination of $\lambda$ [ $^3$ H]DNA Radioactivity

a. Determination of acid insoluble product. Dilute the  $\lambda$ [ $^3$ H]DNA with water to the proper extent, and spot specimens on Whatman 3mm filter paper. Use acid to wash away acid soluble material. Soak the filter paper in 10 percent cold TCA. After 10 minutes, change to a 5 percent TCA and bleach four times, 5 minutes each time. Next use ethyl alcohol and ethyl ether to dry it out and blow dry it with hot air. Place it in xylene scintillation liquid to test for cpm. Use hot air to dry the filter paper sample that has not been acid washed and test for cpm. Using a control specimen with a cpm of 100 percent, compare the cpm of the acid-processed specimen with the cpm of the control specimen to derive the percentage of acid-insoluble material. If checking of the results shows an insoluble material content of more than 99 percent, dialysis has effectively eliminated the acid-soluble material.

2. Determination of the radioactivity gradient using dioxane and the homogeneous method. After diluting the  $\lambda$ [ $^3$ H]DNA sufficiently with water, add 1 microgram of DNA solution to the dioxane scintillation solution to test cpm. Its radioactivity gradient should be  $6.75 \times 10^4$  cpm per gram of DNA

##### 3. Assay of Exonucleases.

Natural  $\lambda$  DNA is the action substrate in exonuclease III, and thermally denatured single strand DNA is the action substrate in exonuclease I and II. When the DNA is cut off of the exonuclease, mononucleotides are liberated. The method for determining acid-insoluble or acid-soluble material can be used to determine the activity of the nuclease. We altered the Berkner [2] method for assaying exonuclease activity to the strip of paper method, assaying the existence of minute amounts of exonuclease contaminants in some zymins.

a. Assaying of exonuclease I and II and indirectly determining the acid-soluble products liberated by a single DNA strand. Use 100 microliters of reaction volume containing 67 mM of glycine-KOH at a pH of 9.5, 1.3 mM of  $MgCl_2$ , 3.3 mM of 2-mercaptoethanol, 50  $\mu$ M of thermal denatured  $\lambda$ [ $^3$ H]DNA and enzyme maintained at a temperature of 37 degrees centigrade. After cooling in ice water, take a 50 microliter specimen and spot it on Whatman 3 mm filter paper strips; then process the filter paper strips in the previously mentioned way, and test



the cpm of the acid residue on the paper strips. By subtracting the cpm of the specimen to which enzyme was added from the control specimen to which no enzyme was added, the non-acid soluble product of the exonuclease I and of the II excision  $\lambda$ [ $^3$ H]DNA is derived. If the cpm in the control sample is taken as 100 percent, the cpm of the non acid-soluble product may be compared with the cpm in the control to calculate the degradation rate on the  $\lambda$ [ $^3$ H]DNA of the contaminated exonuclease per unit of zym.

2. Determination of the activity of exonuclease III contamination, and determination of the acid-soluble products liberated by natural DNA. A 100 microliter reaction volume containing 67 mM of Tris-HCl with a pH of 8.0, 7 mM of  $MgCl_2$ , 8.5 mM of 2-mercaptoethanol, and 50  $\mu$ M of natural  $\lambda$ [ $^3$ H]DNA and enzyme maintained at a temperature of 37 degrees centigrade. The subsequent steps to be followed and calculations to be made are the same as for the exonuclease I and II.

The foregoing applies when optimum conditions are present for the action of exonuclease. Assaying of extremely minute amounts of exonuclease requires maintenance of temperature for a protracted period of time. We used different amounts of enzyme and maintenance of temperature for different periods of time to assay many different kinds of zymins, obtaining satisfactory results. At a temperature of 37 degrees centigrade maintained for 5 hours, when the degradation of  $\lambda$ [ $^3$ H]DNA per unit of enzyme was lower than 0.1 percent, the zym could be regarded as being of excellent quality. Results of the assaying of the exonuclease in three different zymins is shown in Table 1. The results show: the crude enzyme  $T_4$ RNA-linked product was seriously contaminated by exonuclease. No exonuclease I and II contamination activity was found in the  $T_4$ DNA-linked zym; however, after maintaining the temperature for 5 hours, extremely minute amounts of exonuclease II contamination activity could be detected. The  $T_4$  polynucleotide kinase was not contaminated by the exonuclease I and II; however, after maintaining the temperature for 5 hours, contamination activity by the exonuclease III was detected.

Table 1. Assay Results Showing Contaminated Exonuclease Degradation of [ $^3$ H]DNA in Different Zymins

Name	Exonuclease	Maintained Temperature	Average cpm in Three Specimens Used as Controls For Temperature Maintenance	Amount of Enzyme Added (u)	Amount of cpm in Three Specimens to Which Enzyme Was Added and Temperature Maintained	Control minus cpm in test specimen	Degradation Rate (%/u)
$T_4$ RNA-linked Enzyme (Crude)	I and II	37 degrees C, 30 min.	17,292	4.5	6,657	10,640	13.7
$T_4$ RNA-linked Enzyme (Crude)	I and II	37 degrees C, 6 hr	20,863	4.5	1,568	19,295	20.6
III	37 degrees C, 5 hr	22,253	4.5	15,641	6,612	6.6	
$T_4$ DNA-linked Enzyme	I and II	37 degrees C, 30 min	17,277	48	17,877	-	-
$T_4$ DNA-linked Enzyme	I and II	37 degrees C, 30 min plus 18 degrees C, 22 hr	17,567	48	18,085	-	-
$T_4$ DNA-linked Enzyme	III	37 degrees C, 30 min	22,188	48	21,420	768	0.0007
$T_4$ DNA-linked Enzyme	III	37 degrees C, 5 hr	22,170	48	20,543	1,627	0.0015
$T_4$	I and II	37 degrees C, 30 min	7,292	6.6	19,493	-	-
$T_4$	I and II	37 degrees C, 5 hr	29,278	6.6	30,998	-	-
$T_4$	III	37 degrees C, 30 min	22,430	6.6	22,274	156	0.001
$T_4$	III	37 degrees C, 5 hr	22,170	6.6	20,380	1,790	1.2

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Particulars	Arterial blood pressure (mm Hg)				Heart rate (Times/minute)				Respiratory frequency (Times/minute)			
	Pre-medication mean	Post medication peak	Increase/decrease %	P	Pre-medication mean	Post medication peak	Increase/decrease %	P	Pre-medication mean	Post medication peak	Increase/decrease %	P
First dose of scorpion toxin	127±14.8	152±13.8	+19		226±37	213±26.6	-5.7		36.4±10.5	25.8±2.7	21.80	<0.05
	105.±13.7	12.5±12.5	+19									
Second dose of scorpion toxin	12.7±14.8	168±14.5	+32.3	<0.05	226±37	134.4±35.1	-40.5	<0.02	36.4±10.5	17±0.9	52.2	<0.01
	105.±13.7	141±13.3	+34.3									
Anti-epilepsy Peptide i.v.	110	118	+7		210±52	196±39.8	-6.7		35.0	32	8	
	90	98	+7									
Anti-epilepsy Peptide in cerebral ventricle	121±10.7	115±10.6	+4		230±54.5	211±30.5	-8.2		24.75	27.75	12	
	98±8.4	95±6.1	+3									

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9432

### Pharmacological Actions of Scorpion Toxin, Peptides

40082026a Shenyang SHENYANG YAOXUEYUAN XUEBAO [JOURNAL OF SHENYANG COLLEGE OF PHARMACY] in Chinese  
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[Article by Yu Peiyu [0060 0160 3768], Gao Dianzhen [7559 3013 2181], and Liu Yanli [0491 5333 7787], Physiology Teaching and Research Section, and Zhou Xinhua [0719 2450 5478], Biochemistry Teaching and Research Section, Shenyang College of Pharmacy: "Some Pharmacological Actions of Scorpion Toxin and Its Constituent Anti-Epilepsy Peptides"]

[Text] This article reports the effect of toxin from *Buthus martensii* Karsche and of purified anti-epilepsy peptides obtained through the columnar chromatography of the crude toxin on the ECG, the blood pressure, the respiration, and the ECOG of anesthetized rabbits, as well as their effect on the action potential of the sciatic nerves of toads in vitro.

1. Effect on the blood pressure, the cardioelectric field, and the respiration of anesthetized rabbits. An intravenous injection of sodium pentobarbital at a rate of 40

mg/kg was given to anesthetize 10 male and female rabbits weighing from 1.8 to 2.5 kgs each. Then a photoelectric type RM-46 multiconductor was used to monitor and to record blood pressure in the carotid artery, Biao II lead ECG,[sic] and the respiration curve. After recording the normal curves for 15 minutes, the animals were randomly divided into two equal groups, an intravenous injection of scorpion toxin being given to one group at a rate of 0.5 mg/kg. Following injection, the aforementioned physiological curves were recorded for 60 minutes. After all indicators had returned to normal, a second intravenous injection of the same dosage of scorpion toxin was given and physiological curves were recorded for 60 minutes. Anti-epilepsy peptide was given intravenously to the other group at the rate of 1.42 mg/kg, and physiological curves were recorded for 60 minutes. After a return to normal, a microinjector was used to inject 5 gm g of anti-epilepsy peptide into the animals' lateral cerebral ventricle after which physiological curves were recorded for 60 minutes. Results for each 15 minute interval are shown in Table 1.

Results show that the scorpion toxin caused an elevation of arterial blood pressure, a slowing of heart rate, arrhythmia, a slowing of respiration frequency, and finally a cessation of respiration and death. The anti-epilepsy peptide caused no marked differences in arterial blood pressure, heart rate, or respiration frequency no matter whether administered in an artery or in the lateral cerebral ventricle.

2. Effects on anesthetized rabbits' ECOG. Ten rabbits, equally divided between males and females and weighing

from 1.8 to 2.8 kgs, were selected and anesthetized with an intravenous injection of sodium pentobarbital at a rate of 40 mg/kg. A pair of stainless steel electrodes were implanted in the area of the intersection of the seam on the left side of the skull. A hole was drilled on the right to serve as a place for making injections into the cerebrum. A Model RM-46 multiconductor was used to observe and record ECOG. Results showed the ECOG before medication as averaging between 9 and 14 per second, and the amplitude as ranging from 10 to 50 gm V. High amplitude electrical discharge of 50 gm V and above averaged 11 +/-9 per second. The animals were divided at random into two equal groups. One group was given an intravenous injection of scorpion toxin at a rate of 0.5 mg/kg. The other group was given an intravenous injection of anti-epilepsy peptide at a rate of 1.42 kg. Changes in ECOG were observed and recorded. After ECOG had returned to normal, 5 gm g of anti-epilepsy peptide was injected into the lateral cerebral ventricle of each rabbit. Results showed no marked effects on either the frequency or amplitude of the ECOG from the two medications; however, they inhibited electrical discharge at an amplitude of 50 gm V and above. This was particularly marked in the case of cerebral inoculation of the anti-epilepsy peptide. See Table 2 for details.

**Table 2. Inhibiting Effect on ECOG High Amplitude Electrical Discharge of Scorpion Venom and Anti-Epilepsy Peptide**

Series	Pre-medication electrical discharge rate of 50 gm V or more (Times/second)	Post-medication electrical discharge rate of 50 gm V or more (Times/second)	Increase or decrease (%)	P
Intravenous scorpion toxin	11 +/-9	4.5 +/-11.3	-59	0.05
Intravenous anti-epilepsy peptide	11 +/-9	4.2 +/-2.2	-61.4	0.05
Cerebral anti-epilepsy injection	11.8 +/-10.5	3 +/-4.1	-74.6	

3. Function on Toad Sciatic Nerve in Vitro. A photoelectric Type VC 10 memory oscilloscope and a Model RM-46 multiconductor were used to monitor and to record the single phase action potential of the sciatic nerve stem. Results showed normal action potential amplitude of 7.9 +/-2.2 mm. The specimens were later divided into three equal groups. An 0.1 percent procaine solution was used for infiltration of the first specimen group. For the second and third groups, specimen infiltration was done using an 0.1 percent scorpion toxin solution and an intravenous injection solution, respectively. The action potential was monitored and recorded

for 30 minutes. Results showed the peak potential to have completely disappeared after 20 minutes from all the specimens in the first group. In the second and third groups, the action potential had not diminished in the specimens after 30 minutes had passed.

9432/9365

**Effect of Hematocrit on Human Blood Visco-elasticity**  
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No 4, Aug 87 p 49

[Article by Chen Huaqing [7115 2849 0615], Zhong Guihui [6988 6311 6540], Li Liang [2621 5328], and Xue Zhennan [5641 2182 0589], West China Medical College and Biomedical Engineering Research Laboratory, Chengdu: "Effect of Hematocrit on the Visco-elasticity of Whole Human Blood"—a subject funded by the National Natural Science Fund]

[Text] Blood has visco-elasticity at a low shearing rate. Blood visco-elasticity may be expressed as a complex number, the complex viscosity being  $\eta^* = \eta' - i\eta''$  the viscosity component  $\eta'$  and the elasticity component  $\eta''$  varying by 90 degrees. Thurston<sup>[1]</sup> used an oscillation flow capillary tube viscosimeter to measure  $\eta'$  and  $\eta''$ , but that device has marked shortcomings. A Low Shear-30 rheological measuring device can avoid these shortcomings. This article reports the use of such a device in studying the effect of hematocrit (HCT) on ordinary human blood viscosity, on elasticity components, and on the apparent viscosity of whole blood at high, medium, and low shearing rates with the goal of establishing a quantitative correlation among them.

Ten bags of fresh human blood were drawn from the central blood station. The blood had been taken from a vein in front of the elbow of healthy blood donors and sodium citrate powder had been added to it to prevent coagulation. Following centrifuging, the blood plasma was separated from the blood cells, and then different volumes of blood plasma and blood cells were taken to prepare 100 blood samples having different HCT, each sample containing 2 ml of blood that was kept warm in a 37 degree C water bath for 30 minutes after which it was injected into the Couette chamber (37 degrees C) of the rheological device. The blood's apparent viscosities were measured at 0.512, 5.96, and 51.2 seconds<sup>-1</sup> per hour. Blood visco-elasticity was measured using the sine oscillation shear flow at a frequency of 0.0758 Hz, the maximum shear rate being 3.11 seconds<sup>-1</sup> per hour. The viscosity component  $\eta'$  and the elasticity component  $\eta''$  were calculated on the basis of the stress-strain elliptical curve.

The results showed that as HCT increased, the shape of the index curve for the apparent viscosity at the three different shear rates went higher, and the rise of the curve was even steeper at low shear rates:

$$\eta_{0.512} = 2.5747 e^{0.0552 \text{ HCT}} \text{ mPa} \times \text{S. HCT is 100 percent.}$$

$$\eta_{5.96} = 1.39a55 e^{0.0488 \text{ HCT}} \text{ mPa} \times \text{S.}$$

$$\eta_{51.2} = 1.3188 e^{0.0366 \text{ HCT}} \text{ mPa} \times \text{S.}$$

At low and high shear rates, the ratio of the apparent viscosity serves as the red cell clumping index A.I. As HCT increases, the shape of the index curve for A.I. rises. This may be expressed as  $\text{A.I.} = 1.9035 e^{0.0192 \text{ HCT}}$ .

As HCT increases, the shape of the index curve for the viscosity component  $\eta'$  and for the flexibility component  $\eta''$  also rises. The regression empirical formula is as follows:

$$\eta' = 1.2924 e^{0.0518 \text{ HCT}} \text{ mPa} \times \text{s}$$

$$\eta'' = 0.0846 e^{0.0665 \text{ HCT}} \text{ mPa} \times \text{s}$$

$\eta'$  correlates to energy consumption in the blood flow process, and  $\eta''$  correlates to energy conversion in the internal passage of the blood.  $\eta'$  is a sensitivity indicator for red cell clumping in the blood and for red cell membrane rigidity.<sup>[2]</sup> An increase in  $\eta''$  indicates a piling up of red cells in the blood or a marked increase in the network. Alternatively, it may mean a marked decline in red cell membrane rigidity. In normal people, there are no marked changes in the rigidity of red cell membranes; hence, an increase in  $\eta''$  denotes a piling up and an increase in networks of blood specimens. As HCT increases, the number of red cells per unit of volume increases, and as opportunity for cell clumping increases, the pile up increases, and the  $\eta''$  value shows an exponential increase. In addition, when HCT increases and the shear rate is fairly low, because of some piling up, the amount of energy expended in blood flow increases, and the  $\eta'$  value also shows an exponential increase.

Results reported in this article are extremely close to Thurston's results.<sup>[3]</sup>

Under certain conditions both  $\eta''$  and A.I. may serve as objective indicators reflecting red cell clumping;  $\eta''$  is particularly good for this purpose.

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## Characteristics, Usefulness of Various Phytotoxins Described

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[Article by Zheng Shuo [6774 4311], Anti-Chemical Research Institute, Beijing: "Phytotoxic Proteins"]

[Text] Abstract: This article reports the status of research on phytotoxic proteins, particularly highly toxic proteins such as ricin and abrin, providing a description of their botanical distribution, their separation and purification, their molecular structure, their toxicity, their action mechanisms, and their uses.

Phytotoxic proteins are a category of toxic proteins separated from plants that are toxic or act on animals and on intact cells or their cytolyzates, ricin being a representative example. Some of the several known kinds of toxic proteins share structural features and operating mechanisms, and some of them have similar qualities and enzymes. This article will focus on several highly toxic proteins.

## I. Botanical Distribution of Toxic Proteins

China has more than 900 different kinds of toxic plants, most of them in the Ranunculaceae, Rhododendron, Leguminosae, and Euphorbiaceae families. For the most part, their toxic components consist of alkaloids, cardiac glycosides, diterpenes, sesquiterpenes, and wood oils; few are in the protein category.

On the basis of toxicity and structural features, toxic proteins may be divided into two broad classes, the first of which contains five highly toxic proteins including ricin and abrin. In the second category are the low toxicity proteins including croton, curcin, phaseolotoxin, and viscotoxin. They are found largely in Leguminosae, Euphorbiaceae, Passifloraceae, and Loranthaciaea (see Table 1). In addition, the dumbcanin reported as having been separated from Dieffenbachia sequine, an ornamental plant in the Araceae family, is also a toxic protein<sup>[6]</sup>; however, no report of thorough research on this has appeared. Recently a toxic protein that clots the blood, Oxytropis glabra toxin with a molecular weight of 27,500<sup>[8]</sup>, has been reported as having been separated from Oxytropis glabra, a toxic pasture grass in the Leguminosae family.

Table 1. Molecular Weight, Toxicity and Distribution of Phytotoxic Proteins

Type	Name	Molecular weight			LD <sub>50</sub> (mouse i.p.)	Family	Source	
		Complete chain	A	B			Plant name	Portion
Highly toxic	Abrin <sup>[1]</sup>	65,000	30,000	35,000	20 gm/kg	Leguminosae	Abrus precatorius	Seeds
	Ricin <sup>[1]</sup>	62,000	30,000	32,000	7-10 gm/kg	Euphorbiaceae	Ricinus communis	Seeds
	Modeccin <sup>[2]</sup>	63,000	28,000	38,000	0.53 gm/kg	Passifloraceae	Adenia digitata	Root
	Volkensin <sup>[3]</sup>	62,000	29,000	36,000	1.38 gm/kg		A. volkensin	Root
	Viscumin <sup>[4]</sup>	60,000	29,000	34,000	80 gm/kg	Loranthaceae	Viscum album	Whole plant
Low toxicity	Croton I <sup>[5]</sup>				1.33 mg/per	Euphorbiaceae	Croton tiglium	Seeds
	Croton II <sup>[5]</sup>				4.38 mg/per			
	Curcin <sup>[5]</sup>				6.48 mg/per		Jatropha curcas	Seeds
	Viscotoxin <sup>[6]</sup>	5,000			260 gm/kg	Loranthaceae	Viscum album	Whole plant
	Elaterin <sup>[7]</sup>	115,000	4 chains		3.16 mg/kg	Leguminosae	Momordica charantia	Seeds
	Robin <sup>[6]</sup>				1.5 (ma) mg/kg	Leguminosae	Robinia pseudoacacia	Bark
	Phaseolotoxin <sup>[6]</sup> A	126,000-			350 mg/kg		Phaseolus vulgaris	Seeds
	Phaseolotoxin <sup>[6]</sup> B	130,000			250 mg/kg			
	Phaseolotoxin <sup>[6]</sup> C				150 mg/kg			
	Phaseolotoxin <sup>[6]</sup> E				200 mg/kg			

## II. Separation and Purification of Toxic Proteins

All of the several known toxic proteins are glucoproteins that are agglutinins having an affinity for galactose. Ordinarily, Sepharose 4B column adsorption is used, with galactose or lactose being used for washing, and then cellulose ion exchange column chromatography or sephadex gel filtering being used for further purification<sup>[2,9]</sup>. Most low toxicity toxic proteins are also agglutinins, the purification method for which is basically the same as for the foregoing.

There may be slight variations in the structure and characteristics of the toxic content of the same kinds of plants grown in different areas or that are of different varieties. Examples include the ricin D content of the large castor beans grown in Thailand<sup>[10]</sup> versus the ricin D and E of the small castor beans grown in Japan.<sup>[11]</sup> Cawley separated three different variants at the same time from a sub-specie of castor beans from Zanzibar, deriving ricin I, II, and III for which he also determined isoelectric points.<sup>[12]</sup> Taiwan academicians have separated four different variants, abrin a, b, c, and d at the same time from the locally grown Abrus precatorius, the characteristics of which are shown in Table 2.<sup>[13]</sup>

Table 2. Molecular Weights and Toxicity of Four Abrin Variants

Toxin	Complete chain	A	B	LD <sub>50</sub> (mice i.P. gm/kg)
a	63,000	28,000	35,000	10
b	67,000	32,000	35,000	25
c	63,000	28,000	35,000	16
d	67,000	32,000	35,000	31

## III. Structure and Characteristics<sup>[1]</sup>

### 1. Structure, Immunocompetency and Physical Characteristics

Molecular weights of the five different kinds of toxic proteins such as ricin range from 60,000 to 65,000, and are made up of A and B chains, the A chain being somewhat shorter than the B chain, a disulfide bond connecting the two chains. The primary structure of ricin, the toxic protein on which most research has been done, is well known. Its A chain has 265 amino acid residual radicals, and its B chain has 260 amino acid residual radicals. The helical content of chains A and B are 0.3 and 25 percent.<sup>[14]</sup> They both have covalent bond

sugar molecules, the sugar consisting mostly of mannose, glucose, and galactose. These sugars are mostly bonded to the B chain. For example, one of the three oligosugar chains in ricin is on the A chain, and two are on the B chain. In abrin, however, the sugars are all on the B chain. Low toxicity toxic proteins such as croton and curcin, by contrast, are single chains, but elaterin acrasin has four chains.

Some writers have done X diffraction research on toxic protein crystals, discovering that the asymmetrical units of abrin contain two molecules, that space groups are  $P2_1$ ,  $a = 113$  angstrom,  $b = 72$  angstrom,  $c = 71$  angstrom, and  $\beta = 103$  degrees, and solvent content is 45 percent. The asymmetrical units in ricin contain one molecule, and space groups are  $P2_12_12_1$ ,  $a = 73$  angstrom,  $b = 79$  angstrom, and  $c = 114.7$  angstrom; alternatively space groups are  $C2$ ,  $a = 117$  angstrom,  $b = 57$  angstrom,  $c = 92$  angstrom, and water of crystallization content is 68 percent.<sup>[1]</sup>

The use of electronic microscopes to study the shape of viscotoxin molecules has been recently reported. This research showed single molecules to have an  $80 \times 90$  angstrom nearly triangular or spherical shape, and double molecules (i.e., dimers) to be club shaped,  $175 \times 80 \times 60$  angstrom.<sup>[15]</sup>

Formaldehyde processing of ricin, abrin and modeccin produced similar toxins, which were capable of producing immunity when injected into animals. The immunoserum could effectively protect animals and nurture cells, as well as protect against poisoning caused by corresponding toxins. Immunologically, these toxins differ, and they do not substantially interact with each other. Anti-B chain antibodies can effectively inhibit B-chain bonding to cell surfaces, and Anti-A chain antibodies can effectively safeguard the protein combining function of cytolyzates, and avoid inhibition by the A-chain.

Effects on the toxicity of intact toxins of repeated freezing and thawing were very slight. A toxin in a 0.1 M galactose solution could be stored in a refrigerator for several months without loss of potency; however, boiling destroyed potency. Separated chains were more unstable than intact toxins.

## 2. Toxicity

Toxins composed of two chains usually were highly toxic (see Table 1 and Table 2); however, toxification was slow, symptoms appearing several hours after administration of the toxins. The main symptoms from poisoning with ricin and abrin were loss of strength and revulsion against eating, with no specific clinical manifestations. Following toxification, the number of white blood cells decreased gradually, principal damage occurring to the liver. In poisoning from viscotoxin, peritoneal fluid, intensinal hyperemia and pancreatic bleeding were present.<sup>[4]</sup> Modeccin poisoning produced mostly damage

to the liver, and poisoning by the plant produced vomiting and bloody diarrhea followed by death. Single chain toxins such as croton and curcin did not have strong toxicity, and poisoned even more slowly.<sup>[12,16]</sup> When viscotoxin was given other than via the alimentary canal, the test animals' hearts fluttered and slowed; negative muscles contracted; and low blood sugar resulted.<sup>[6]</sup>

Highly toxic toxic proteins are also highly toxic to the culturing of cells. Ricin and abrin at a strength of 1 ng/ml, and modeccin at a strength of 3 pg/ml killed cells. Single chain toxic proteins had no toxicity or very weak toxicity for the culturing of cells, largely because they were unable to invade the cells.<sup>[5]</sup> By increasing toxin concentration and lengthening the incubation period, toxicity could be increased slightly.

## 3. Operating Mechanisms

Research on ricin has demonstrated that toxic proteins are cell toxins. Once the toxin enters an organism, the B chain bonds to cell surfaces, and enters the cell through a process of deglutition. The A and B chains separate, the A chain penetrating the cell membrane and entering the cytoplasm causing the ribosome to lose competency, thereby inhibiting protein synthesis. The B chain can advance the entry of the A chain. When the ribosomes of a eukaryocyte are inhibited, a bacteria's [as published] ribosomes resist. The A chain in ricin and abrin cause a loss of competency of ribosomes at a rate of 1,500 per minute. They mostly inhibit the onset of peptide chain formation and growth, formation of peptide bonds seemingly not being inhibited. The place where the action takes place is the same or very close to the location where ribosomes and prolongation factors bond. Highly viscous prolongation factors can partly prevent this inhibiting function.

Intact toxins having two chains do not act on cytolyzates, because the toxin's A chain has not been freed, and only one chain's single chain toxin is active. Because they themselves are like a free A chain, their action mechanism is the same as an A chain.<sup>[5,17]</sup>

## IV. Application

Crystalline abrin and ricin had a marked effect on Aishi [5337 3044] peritoneal fluid cancer cells, on  $L_{1210}$  leukemia, on  $B_{16}$  nevocarcinomas, and on Lewis pulmonary carcinomas. They killed cancer cells by inhibiting protein synthesis. It was also found that they increase the effectiveness of some drugs. For example, when ricin is used in conjunction with adriamycin, effectiveness against leukemia cells is markedly increased.<sup>[1]</sup>

At the present time, mostly toxin A chains and monoclonal antibodies in combination form immunotoxins for killing cancer cells. For example, if the A chain of



ricin and antibodies induced from antigens in lymphoblast leukemia cells are used together to form an immunotoxin, proliferation of positive cells against the antigens can be effectively inhibited.<sup>[18]</sup> Use of single chain toxic proteins whose physical action is similar to that of A chain low toxic single chains to develop anti-cancer immunotoxins is of even more value, because the separation and preparation of such proteins is simple, and side effects few when they are put into an organism.

In addition, since toxic proteins such as ricin bond solely with polysaccharides or glucoproteins containing galactose terminal residual radicals, the glucoproteins, glycolipids, and polysaccharides containing corresponding sugar radicals having an affinity for absorbents and that can separate and purify can be used. In addition, they may be used in the study of the distribution of sugars on cell surfaces, thereby becoming a powerful tool in the study of the structure of cell membranes.

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SHENGWUWULI JINZHAN [PROGRESS IN  
BIOCHEMISTRY AND BIOPHYSICS] in Chinese  
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[Article by Miao Jisheng [5379 4480 3932], Wu Jiyong [0702 0679 0516], Shen Yi [3088 3015], Huang Liquan [7806 0448 5028], and Tan Lisong [6151 4539 2646], No 1 Sanatorium, Shanghai Municipal Tuberculosis Prevention and Treatment Center: "Separation and Purification of Abrin and Its Two Peptide Chains"]

[Text] Abstract: Abrin consists of two peptides, A and B, and it is one of the most toxic proteins for animal cells. The A chain is the toxic part of the toxin, and the B chain is the toxin vector, which carries the A chain to the target cells and kills the cells. This article reports the method and steps that we took to extract and prepare abrin and its A and B chains, as well as how we analyzed and evaluated each component part. Some improvements in methodology were made.

Semen jequiriti, which is also known as the love pea, was called xiangsizi [4161 1835 1311] or wild liquorice in ancient medical texts, and was used as a toxic medicinal herb<sup>[1]</sup>. During the 1960's, abrin and abrus agglutinin<sup>[2]</sup> were extracted from it. Abrin is extremely toxic. Several tens of micromilligrams injected into a mouse will produce death. Abrus is very weakly toxic, but it causes agglutination of the red cells of certain animals. The molecular weights of the two toxins are 65,000 and 130,000 respectively. The toxins consist of two peptide chains connected by a disulphide bond, which can be broken apart through processing in 2-mercaptethanol. The relatively small peptide chain has been termed the A chain. It has a molecular weight of 30,000, and it is the toxic part of the toxin. The other fairly large peptide chain is the B chain. It has a molecular weight of 35,000, and it is the vector for the toxin. It is able to bond the glucoprotein containing galactose residual radicals on cell surfaces. It carries the A chain, which invades the cells, killing and injuring them<sup>[3,4]</sup>.

Abrin is very toxic to eukaryocytes. Analysis shows that the entrance into a cell of a single toxin molecule can kill the cell<sup>[5]</sup>. The toxin holds a certain specificity for killing and injuring tumor cells; consequently, experimental research has begun in foreign countries in the clinical application of the toxin to the treatment of tumors<sup>[6]</sup>. With advances in monoclonal antibody techniques, experimentation and clinical research has been undertaken whereby the complete toxin or its A chain are



connected either through dual function reagents or monoclonal antibodies to produce guide toxins (immunotoxins) that are specific for killing and damaging tumor cells. This work has increasingly aroused serious attention. This research may very possibly score major advances for the treatment of tumors with drugs.

This article describes the process whereby our laboratory extracted and prepared abrin and its A and B chains. It also analyzes and evaluates each component, and makes some improvements in methodology.

## Materials and Methods

### 1. Toxin Preparation

Extraction of toxin. Semen jequiriti was purchased from Sichuan Province. After removal of the shell, it was soaked in a 5 percent acetic acid solution at 4 degrees C overnight. It was then mashed in a tissue blender, chilled and centrifuged at 8,000 g for 20 minutes after which the clear liquid was removed. The sediment was collected twice and combined with the clear liquid. To the liquid was added 5 mol/L of NaOH to adjust the solution to a pH 5. Then solid  $(\text{NH}_4)_2\text{SO}_4$  was added to produce 70 percent saturation, and it was set aside at 4 degrees C for 1 hour after which it was chill centrifuged at 8,000 g for 20 minutes. The sediment consisted of a small quantity of aqueous solution, which was a crude toxin specimen.

### Gel Filtration, Desalinization and Purification

A Sephadex-G75 chromatographic column (2.8 x 100 cm) was used with 10 mmol/L of a Tris-HCl buffering solution (hereinafter referred to only as the buffering solution) at a pH of 7.7 for neutralizing. The pH of the crude specimen was adjusted to 7.7 by using 0.2 mol/L of Tris. Each time 20 ml were put into the column from which the speed of flow was 15 ml/hr (the same applying hereinafter). When the discharge volume reached 100 ml, collection was begun. It was halted at 180 ml, when a total of 80 ml had been collected.

Positive ion exchange chromatography. After alkalai and acid processing, DEAE-cellulose (DE 52) was put into the column (1.5 x 30 cm) and a buffering solution was used to neutralize it. The gel filtered specimen was put into the column, and 300 ml of buffering solution was used to wash it. Finally a similar buffering solution containing 0.1 mol/L of NaCl was used for elution, the liquid being collected in separate tubes (approximately 3 ml per tube). A 280 nm wave length was used to determine protein viscosity.

Affinity chromatography and purification. After processing in a Sepharose-4 B chromatographic column (1 x 35 cm) containing 1 mol/L of propionic acid, a buffering solution was used for neutralization. The specimen obtained from the DE 52 chromatographic analysis was put into the column, and this time the abrin and the abrus agglutinin were combined into the gel. Next it was

washed in 100 ml of buffering solution, and eluted with a buffering solution containing 0.05 mol/LD of galactose and 0.2 mol/L of NaCl. Collection in separate tubes was done in the same manner described above. A 280 nm wave length was used for colorimetry, and part of the abrin sample was put back into the Sephadex-G75 column, and the procedure described above done again. This time, only a single protein eluent peak was derived, i.e., for pure toxin.

### 2. Isolation of the Toxin A and B Chains

The toxin should be made up into a solution containing 0.5 mol/LD of galactose and 5 percent 2-mercaptethanol. After letting stand for 1 day at 4 degrees C, an equal volume of distilled water should be added, and the solution centrifuged. The pH of the resulting supernate should be adjusted to pH 5 by using 0.2 mol/L of Tris. The previously prepared 10 mmol/L of Tris-HCl DEAE-cellulose at pH 8.5 that has been neutralized with a buffering solution should be added to the chromatography column (2.2 x 12 cm). Collection in separate tubes, as above, should be done in addition. After the specimen has finished flowing, it should be eluted using 100 ml of the above-mentioned buffering solution containing 2 percent 2-mercaptethanol, and then eluted again with 200 ml of buffering solution that does not contain 2-mercaptethanol. The protein solution that is not put into the column is the B chain. Finally, elution is done using the 0.2 mol/L NaCl buffering solution. The protein that is derived is the A chain. The pH of both the A and B chain solutions that have been derived should be adjusted to 7.7 by using 1.0 mol/L of HCl, and each should be purified in a Sepharose-4B column (using the aforementioned affinity chromatography and purification method). The portion not put into the column is the purified A chain. The portion that has been washed down with D-galactose after having been placed in the column is the purified B chain.

### 3. Evaluation of the Toxin and Its A Chain

Toxicity Testing. Healthy mice weighing from 18 to 25 grams (their sex being of no relevance) were injected in the peritoneum with 1 ml of different doses of test samples and their mortality observed over a 5-day period. Injection with a physiological saline solution was used as a control.

### Measurement of Blood Agglutination Titre

Healthy human red blood corpuscles were washed three times with PBS to form a 5 percent red corpuscle suspension. A test sample solution of a known concentration was diluted with a equal volume of PBS to a serial concentration, and amounts were added separately to agglutination plate apertures. Next an equal volume of the 5 percent red corpuscle suspension was added, and the solution was cultured at 37 degrees C for from 20 to 60 minutes, and the number of agglutination apertures observed. PBS was used as a control.

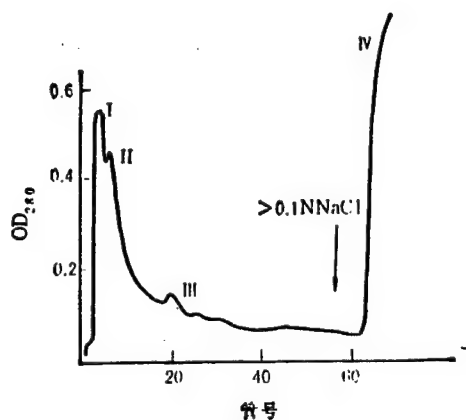


Figure 1. DEAE-Cellulose (DE52). Toxin separated by chromatography

**SDS Electrophoresis.** SDS electrophoresis was done on the purified toxin to determine purity. SDS concentration was 7.5 percent, and a phosphoric acid buffering solution was used. A standard protein specimen was used as a control, and the molecular weight of the toxin and its A and B chains were determined.

**Gel Filtration. Assay of A Chain Competency.** Sephadex-G75 gel filtration was used, and a standard protein specimen was used as a control in a determination of the comparative molecular weights of specimens.

After mercapto group exposure, the A chain was connected to a ricin B chain to produce a hybrid toxin molecule, and the aforementioned assaying method was used to make measurements.

## Results

### 1. Toxin Purification

Though the specimen obtained from the Sephadex-G75 chromatography of crude toxin contained toxic protein, because there were too many protein impurities it was impossible to obtain a clear-cut pure toxin eluent peak. Only following ion exchange chromatography was it possible to separate out a clear-cut eluent peak for the toxin (see Figure 1). Peaks I, II, and III contain toxin. Agglutinin remained in the column that required use of an NaCl solution greater than 0.1 mol/L to wash it down (see Peak IV). Specimens at peaks I, II, and III were put together in a Sepharose-4 B column. Please see Figure 2 for elution results. There is only one toxic protein peak, namely Peak V. Repeated chromatographic analysis using the Sephadex-G75 column was done to obtain purified toxic protein (see Peak VI in Figure 3).

### 2. Toxin Evaluation

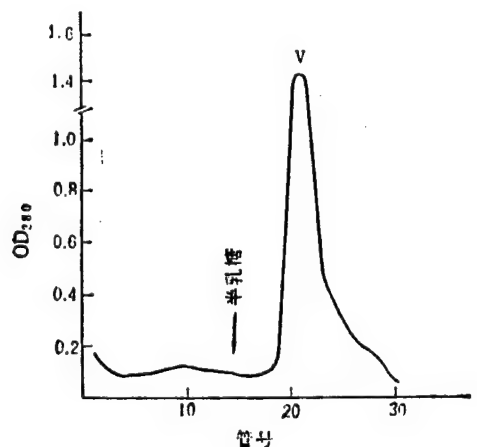


Figure 2. Sepharose-4B Purified Toxin

The purified toxin was used to determine the agglutination titre. This showed that there was virtually no concentration action, which was in keeping with toxins characteristically having no concentration action. Sephadex-G75 column chromatography and SDS electrophoresis (see (1) toxin in Figure 4 [not reproduced]) were used to rate the molecular weight of this protein at approximately 65,000, which is consistent with pertinent reports<sup>[4]</sup>. Results of the toxicity assay showed that 0.185 micrograms per milliliter of toxin can induce death in mice. Its toxicity is very high and close to that reported in references. Results of SDS electrophoresis and of polyacrylamide gel electrophoresis (see toxin in Figure 5 [not reproduced]) show this toxin can reach electrophoresis purity.

### 3. A and B Chain Preparation

After processing the purified toxin in mercaptoethanol, SDS electrophoresis was done, which yielded two bands. See (2) A and B separation in Figure 4. The one with the small mobility is the B chain; the one with the large mobility is the A chain. For the eluent curve for the A

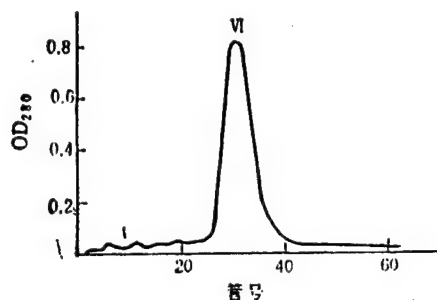


Figure 3. Sephadex-G75 Purified Toxin

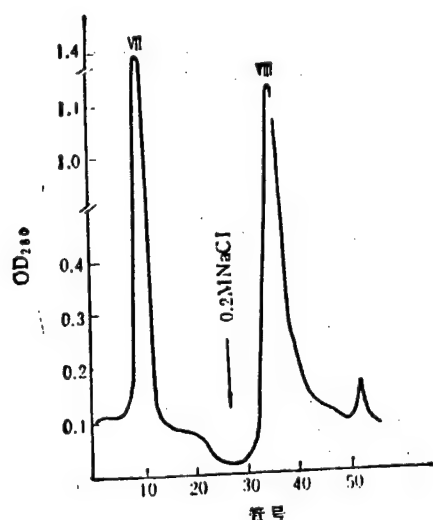


Figure 6. Abrin A and B Chain Separation

and B chains obtained through DEAE-cellulose chromatography separation, please see Figure 6 in which Peak VII is the B chain. Peak VIII, which has been washed down with an NaCl solution is the A chain. After individual purification by Sepharose-4B chromatography, a pure A and B chain product was derived.

#### 4. Evaluation of A and B Chains

Analysis showed virtually no agglutination by A and B chains. SDS electrophoresis determined their molecular weights to be approximately 30,000 and 35,000 respectively, attaining electrophoresis purity, which is consistent with relevant reports (please see (3) A Chain and (4) B Chain in Figure 4). Toxicity assay showed A chain to be approximately 40 gm, and B chain approximately gm, insufficient to induce death in mice, which was similar to the findings of reference report<sup>[4]</sup>.

After A chain was connected to the B chain of ricin at 20 times the volume, indirect testing of A chain competency was done. Each mouse was injected with a dosage equivalent to 0.32 gm of the A chain before it was linked to the ricin B chain (or 0.64 gm of ricin B chain). This caused the death of the mice within 40 hours. However, injection of either 40 gm of a chain alone, or as much as 400 gm of ricin B chain alone, did not cause the mice to die demonstrating that only when A chain and the B chain of ricin were linked together to form a hybrid toxin did toxicity result. If all the A chain and all the B chain had been linked to form a hybrid toxin, only a maximum of 0.64 gm of hybrid toxin would have been produced, and its toxicity would have been close to that of a complete abrin toxin. This shows that the A chain prepared above retains substantially the same competency as the original toxin.

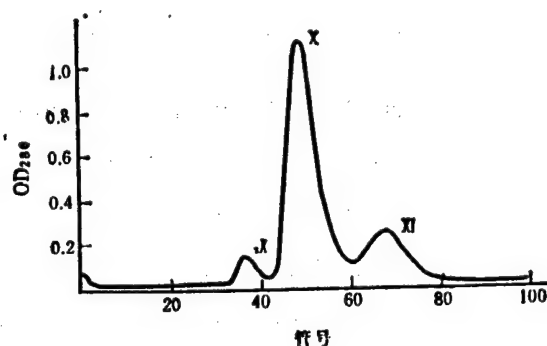


Figure 7. Sephadex-G75 Purified Abrin

#### Discussion

The method that this article presents for extracting and purifying abrin and for separating and purifying its A and B chains is fairly straightforward and can be done in most laboratories. The key to toxin extraction lies in elimination of agglutinin. Unlike the method described in most references, we used Sephadex-G75 gel filtration to separate the agglutinin from the toxin, thereby obtaining a rather pure toxin. The following assays were done in this connection: A crude specimen of the toxin was put directly into the Sepharose-4 B column for affinity chromatographic analysis after which gel filtration to effect separation was done in a Sephadex-G75 column. Please see Figure 7 for the eluent curve for the protein obtained. It is made up of three protein peaks, labeled IX, X and XI. Evaluation and comparison<sup>[3,4]</sup> permitted the conclusion that Peak XI is toxin that does not agglutinate red blood cells, approximately 0.25 gm of which are needed to kill a mouse. Peak X is agglutinin that has a strong coagulative effect on red corpuscles, but a content of 1 gm does not produce death in mice. The volume range of gel filtered pure toxin collected in the aforementioned "method" has been extrapolated from this result.

References have all used SDS electrophoresis to evaluate toxin purity, but we used the polyacrylamide electrophoresis method. Assay results show that separation of toxin from agglutinin is easier with the latter than with the former method.

The method for determining indirectly the competency of the A chain is handy and reliable. It is a very good substitute method for assaying retardation of protein synthesis in non-isotopic osmosis tracing of a cell-free system. It does not require expensive equipment and may be performed in an ordinary laboratory. This is of very great value in the preparation of the A chain of toxins and in applied research on them.

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9432/6091

**Toxicity of Certain Myrothecium Strain Tested**  
40082026b Beijing WEISHENGWUXUE TONGBAO  
[MICROBIOLOGY] in Chinese  
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[Article by Liang Zenghui [2733 1073 6540], Yang Zongfen [2799 1350 5358], Cheng Yiyong [4453 5030 0516], and Jiang Xingjin [5592 5281 6930], Armed Forces Health Research Institute, Academy of Military Medical Sciences: "Toxins Produced by Myrothecium W<sub>96</sub> Surveyed"]

[Text] Abstract: In the course of a health survey, we separated a strain of myrothecium (Myrothecium W<sub>96</sub>) from a layer of floating matter that had grown on the surface of a water storage pond in north China. After purification and culturing, it was cultured in a laboratory in natural culturing media, namely corn, wheat, and rice. Next, a crude extract from the culture was used to conduct rabbit skin sensitivity tests and tests on inhibiting pea germination. The tests showed that the crude extract taken from the Myrothecium W<sub>96</sub> corn and wheat culture produced symptoms of sensitivity on the rabbits' skin including redness, swelling, and blistering. Results of the experiment on the inhibition of pea germination also showed a toxic reaction. Both the rabbit skin sensitivity experiment and the pea germination inhibition experiment showed this strain of strain of myrothecium as being able to produce mycotoxins.

Key terms: Fungi; mycotoxins; mycoclature; and myrothecium

References<sup>1,2</sup> have long reported that myrothecia are able to produce antibiotic substances such as gliotoxin and dermatitis-producing substances similar to toxins from the Rhus toxicodendron family of trees. Reportedly cattle and sheep that eat grass that has been contaminated with myrothecia show symptoms of myrothecium poisoning. Myrothecium toxins are markedly toxic to white mice, white rats, rabbits, dogs, pigs, and monkeys. In the course of one health survey, we happened to separate a myrothecium strain (Myrothecium W<sub>96</sub>) from myrothecium floating matter that covered the surface of

a water storage pond. In the laboratory, we used natural culturing agents to culture it, and we tested crude extract from this culture for toxins. We discovered that Myrothecium W<sub>96</sub> produces mycotoxins. Results of the experiment are provided below.

#### Materials and Methods

##### (1) Myrothecium Strain Provided for Testing

Myrothecium W<sub>96</sub> was obtained from the separation of mold that covered the water of a water storage pond in north China. The mold grew in an environment with an ambient temperature ranging from 11.8 to 12.7SDC (the air temperature having been taken on four different occasions during the same season for 4 years running), and the mold grew on the surface of stored water where there was no light. The separated mold was taken to a laboratory for purification and culturing, and it was assessed by the Microbiology Research Institute of the Chinese Academy of Sciences as being of the Myrothecium family. The Myrothecium W<sub>96</sub> was cultured for 14 days at 28SDC in a Caishi [5591 3044] culturing medium. The mold colonies measured between 4 and 5 cm, and gelatinous secretions were apparent. The hyphi were colorless, greenish black spores, with white around the edges of the colonies.

##### (2) Culturing Medium

1. Slant Culture Medium: Separation and purification of molds was done using potato agar slant and Caishi culturing medium slant.

2. Natural Culturing Medium: In order to observe the ability of the myrothecium to produce toxin, corn, rice, and wheat culturing media were placed in separate Loshi [5012 3044, possibly Roche] flasks to which was added tap water for soaking. The corn and wheat were soaked for 24 hours, and the rice was soaked for 2 hours. The water was drained away, and steam pressure at 1 kg/cm<sup>2</sup> was applied for 30 minutes to kill bacteria. This was done twice.

##### (3) Drawing Off Crude Extract

The Myrothecium W<sub>96</sub> was inoculated into potato agar slant at 28SDC and cultured for 14 days. Then, separate portions were inoculated into the three natural culturing media, namely the corn, rice, and wheat cultures in which bacteria had been killed twice, where they were cultured at 28SDC for 2 weeks, being shaken once each day. After the culture was subjected to circulating steam to kill the mold that had been cultured, pressure was reduced and temperature raised to 70SDC to dry the mold. Fifty grams of the culture was added to 150 ml of 1 percent methyl alcohol and sodium chloride at a proportion of 55 to 45 parts, and the mixture was shaken for 2 hours. After filtering, another 150 ml of the methyl alcohol and sodium chloride mixture was added. This was shaken again and extracted. The liquid was filtered,

and after pressure was reduced and evaporation drying was done, 20 ml of methyl alcohol was added to dissolve the filtrate, and 10 ml of n-hexane was used for two separate extractions. To the methyl alcohol solution was added 10 ml of chloroform and ethyl acetate (1:1), and extraction done twice. The chloroform was evaporated to yield an oily crude extract that provided toxins for examination.

#### (4) Toxicity Testing

1. Experiment on Pea Germination Inhibition. The Burmeister<sup>3</sup> method was applied. Healthy pea seeds were soaked in an 0.1 percent solution of mercuric chloride for 20 minutes to disinfect them; then they were washed three or four times in bacteria-free distilled water. The crude extract of the *Myrothecium W<sub>96</sub>* culture was dissolved in acetone at a concentration of 4 g/ml (of dried culture, the same applying hereinafter). Then 1 ml was placed in filter paper on a disinfected culturing dish, and after the acetone had volatilized and dried, 4 ml of bacteria-free water containing 0.1 percent jiejie-ling [3381 3381 7227] was used for dilution, so the measured concentration equaled 1 g/ml. Into each dish was placed 10 peas, and then they were put aside at 28SDC for 3 days. At the same time, crude extracts from the three natural corn, rice, and wheat culturing media that had not been contaminated with mold were used as a blank control.

2. Rabbit Skin Irritation Experiment: Using Chung's method,<sup>4</sup> a young white rabbit weighing approximately 2 kg was shaved bare on its back and both sides. Then 10 gml of crude extract at a concentration of 40 mg/gml (dried culture) that had been dissolved in acetone was dropped on the rabbit's skin and smeared to cover an area of approximately 1 m<sup>2</sup>. At the same time, crude extracts from the three natural corn, rice, and wheat culturing media that had not been contaminated with mold were used as a blank control.

#### Results and Discussion

##### (1) Experiment on Pea Germination Inhibition

For details about the extent to which pea germination was inhibited by the crude extract of *Myrothecium W<sub>96</sub>* cultured in the three natural corn, rice, and wheat culturing media, please see Table 1.

Table 1. Extent to Which *Myrothecium W<sub>96</sub>* Crude Extract Culture Inhibited Pea Germination (percent)

Kind of extract	Mean inhibition rate	Control*
Corn culture	97.7	6.0
Wheat culture	95.2	2.0
Rice culture	7.0	6.0

\*Nongermination rate for regular peas

Burmeister<sup>3</sup> reported that when the mold toxin and the T<sub>2</sub> toxin content is 2.0 gm g/ml, the inhibition rate for pea germination was more than 90 percent. When the T<sub>2</sub> toxin content was less than 0.25 gm g/l, the inhibition rate was less than 10 percent. Table 1 results show pea germination inhibition rates of 97.7 and 95.2 percent for the crude extract of *Myrothecium W<sub>96</sub>* cultured in corn and wheat culturing media. This shows a fairly large mycotoxin content in the crude extract. However, there was no toxic reaction for the crude cultured in the rice culturing medium.

##### (2) Experiment on Rabbit Skin Sensitivity

Ten gml of the crude extract of the *Myrothecium W<sub>96</sub>* that had been cultured in the three natural corn, rice, and wheat culturing media are daubed on the rabbit's skin. Please see Table 2 and Figures 2 and 3 [figures not reproduced] for toxicity results.

Table 2. Toxic Effect on Rabbit's Skin of *Myrothecium W<sub>96</sub>* Culture Extract

	Level of skin toxic reaction			
	1 day	3 days	5 days	7 days
Wheat culture	+	++	++++	++++
Corn culture	-	+	+++	++++
Rice culture	-	-	-	-

Note: "-" means that crude extracts of corn and rice cultures not contaminated by mold were negative, with no skin reaction; "++ to +++" means redness and swelling of the skin with blisters; and "++++" means necrotized skin tissue.

Table 2 and Figures 2 and 3 [figures not reproduced] show that rabbit skin that had been daubed with the chemical exhibited sensitivity symptoms of redness, swelling, and blisters, with necrotizing of tissue appearing on the seventh day. These results show that the metabolic products of *Myrothecium W<sub>96</sub>* cultured in corn and wheat culturing media were rather highly toxic and were able to produce dermatitis-producing substances. Results of the pea germination inhibiting experiment and the rabbit skin sensitivity experiment were identical in that they proved this conclusion. The metabolic products of the *Myrothecium W<sub>96</sub>* cultured in the rice culturing medium showed no toxic reaction.

Both the pea germination inhibition experiment and the rabbit skin sensitivity experiment used biological toxicity test methods used for the testing of single-end spore mold toxins that are rather sensitive. References have reported that 3 of 13 different members of the myrothecium family are able to produce toxins that are toxic to mammals including single end spore mold toxin, Verrucarins toxin, and Roridins toxin.<sup>2</sup> Observations made during this experiment showed very rapid growth of



myrothecium in the corn and wheat culturing media as well as the production of mycotoxins. Care should be exercised against poisoning from the accidental eating of food that has been contaminated with myrothecium.

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- 9432/9365

**Effect of Ammonia Ion and Chloride Ion on L-Glutamine Fermentation**  
4081003a Beijing WEISHENGWUXUE TONGBAO  
[MICROBIOLOGY] in Chinese  
Vol 14 No 4, Aug 87 pp 153-156

[Article by Wang Fuyuan [3769 4395 3293], Wang Miaohu [3769 1181 5706], and Wang Jinhua [3769 6930 5478] et al of Shanghai University of Science and Technology; and Yu Rujun [0205 0320 6874], Tianchu Monosodium Glutamate Plant]

[Abstract] Under mild acidic conditions, fermentation of glutamic acid will change into fermentation of L-glutamine. The paper presents different fermentation results from using ammonium sulfate and ammonium chloride as nitrogen sources, as well as the effect on fermentation by  $\text{NH}_4^+$  and  $\text{Cl}^-$  ions when ammonium chloride is used. As explained by experimental results, the maximum L-glutamine and the minimum glutamic acid will be produced when 0.75N ammonium chloride is the nitrogen source. In the fermentation, L-glutamate formation will be significantly affected whether  $\text{Cl}^-$  or  $\text{NH}_4^+$  is introduced.

Two figures show the effect of  $\text{NH}_4\text{Cl}$  on fungus growth and sugar utilization. Four tables show the effects of product formation by different concentrations of  $\text{NH}_4\text{Cl}$ , and by  $\text{SO}_4^{2-}$  and  $\text{Cl}^-$  ions; growth of L-glutamine at different ion concentrations, and the effects of  $\text{NH}_4^+$  on fungus growth and L-glutamine formation.

10424/12913

**Gas Chromatographic Determination of Drug-Resistance of Mycobacterium Tuberculosis**  
40081013c Beijing WEISHENGWUXUE TONGBAO  
[MICROBIOLOGY] in Chinese  
Vol 14 No 4, Aug 87 pp 168-170

[Article by Mei Guohua [2734 0948 5478], Cheng Donge [4453 0392 1230] and Cai Yuzhen [5591 3768 3791] of Tuberculosis Hospital, Wuhan Iron and Steel Corporation; and Zhang Tianmin [1728 1131 3046], Wuhan Metallurgy Related [occupation diseases] Medical School]

[Abstract] The drug resistance of mycobacterium tuberculosis was studied using gas chromatography. In a comparative test contrasting gas chromatography and the conventional method, the agreement was 86.4 percent between these two methods. In gas chromatography, relatively accurate results can be obtained by six days, two weeks faster than by the conventional test tube method. This shows that gas chromatography is practical though it still has some problems, namely: higher instrument costs, more complicated operation, and more factors leading to inconsistent results.

Three tables show the final concentrations of the testing drugs in culture media,  $\text{CO}_2$  determination results, and comparative test results of isolated strains from 68 clinical cases. The authors are grateful to associate professors Wu Caiying [0702 6846 2937] and Da Shilu [6671 0013 4389] of the Department of Chemistry, Wuhan University, for their advice.

10424/12913

**Vibrio Cholera Gene Probe Construction Explained**  
40081032 Beijing WEISHENGWUXUE TONGBAO [ACTA MICROBIOLOGICA SINICA] in Chinese  
Vol 27 No 3, Sep 87 pp 244-248

[Article by Zhou Jianguang [0719 1696 0342], Ma Qinggou [7456 3237 6869], and Xiong Lingshuang [3574 0407 7208], Institute of Basic Medical Science, Academy of Military Medical Sciences, Beijing, and Zhou Jianxin [0719 1696 2450], Biochemistry Teaching and Research Section, The Third Military Medical University: "Construction of V. Cholerae Toxin Gene Probe and Its Use For the Detection of V. Cholerae"]

[Text]Abstract: A recombinant plasmid pMM-CTII containing a cholerae toxin (CT) gene was constructed in vitro. The specific DNA fragment from the CT gene was obtained by XbaI and EcoRI double digestion of pMM-CTII followed by agarose gel electrophoresis and labeling with  $\alpha\text{-}^{32}\text{P}$  using nick translation technique. The labelled CT probe showed positive hybridization results with classical V. cholerae O1 group and Eltor toxigenic strains, and negative hybridization results with O1 group nontoxigenic strains. We also identified 52 epidemic and 50 resistant strains of V. cholerae Eltor, which were typed



by bacteriophages and isolated from clinical specimens and environment. The detection rates for toxigenic strains were 92 and 16 percent respectively. This shows that CT gene analysis to be more accurate and dependable than the bacteriophage classification method.

**Key Words:** Gene probe; cholerae toxin. *v. cholerae*

Cholera is an epidemic disease found all over the world. The onset of cholera is brought about by infection with cholerae toxins (CT) produced by *vibrio cholerae* [*v. cholerae*]. The *v. cholerae* toxin gene is located on a chromosome, and is homologous 76 percent of the time with the uronic sequence of the heat-labile enterotoxin (LT) coded by enterotoxin *E. coli*. Consequently, the application of an LT gene probe under non-rigorous hybridizing conditions can also detect the cholera toxin gene. However, it should be noted that non-rigorous hybridizing conditions may sometimes produce a false positive result.

We applied genetic engineering techniques successfully on *E. coli* to obtain clones and expression of CT gene recombinant plasmids (pMM-CT). For ease in manipulation of the CT gene probe, the pMM-CT was reconfigured, the recombinant plasmid pMM-CTII that was obtained containing a CT gene but being unable to produce toxin. Thus it was possible to safely and conveniently use it to prepare a CT gene probe, and this CT gene probe successfully detected bacterial strains that were isolated from clinical specimens and from the outer environment. Engineering microbe screening authenticated it.

## Methods and Materials

### (1) Materials

O 1 group *v. cholerae* 569 B, Eltor *v. cholerae* 178, Wujiang 2, non-O 1 group *v. cholerae* O 37, and N 53 were provided by the Ministry of Public Health Pharmaceutical Products Appraisal Institute. The O 1 group of epidemic strains of Elton *v. cholerae* that were isolated from clinical specimens and from the outer environment, and resistant strains were authenticated and supplied by Mr. Bao Xinghao [7637 5887 6275] of the Zhejiang Provincial Epidemic Prevention Station, by Mr. Jiang Degao [3068 1795 2640] of the Zhejiang Provincial Academy of Medicine, and by the Academy of Military Medical Science's Institute of Microbiology and Epidemic Diseases. The *E. coli* containing LT gene recombinant plasmid EWD 299, the O 1 group of *v. cholerae* non-toxic strains 1196-78 and 1074-78, as well as the O 1 group of *v. cholerae* toxic strain O 395 were presented by Professor W. K. Mass of New York University in the United States.

The restriction endonuclease, the T 4 DNA ligase, the DNase I, and the DNA polymerase I were products of Biolab.

The radioactive isotope [ $\alpha$ - $^{32}$ P] dAPT was an Amersham product.

### (2) Methods

1. DNA preparation. Recombinant plasmid construction and analysis: Preparation of the chromosome DNA of the *v. cholera* 569 B strain was done by following the Marmur method.<sup>[2]</sup>

Plasmid extraction, restriction enzyme digestion, DNA in vitro linking and transformation, colony hybridization, and agarose gel electrophoresis molecular hybridization were conducted with the method described in reference 3.

Preparation of the LT gene probe and of the CT gene hybrid conditions was done in accordance with the method described in reference 4.

2. Assay of toxin's biological activity. A Y<sub>1</sub> adrenal gland cell assay of the cholera toxin was done according to the method described in references 5 and 6.

Rabbit intestine experiment with cholera toxin. The peritoneum of a healthy rabbit weighing approximately 2 kgs was cut open and the jejunum and ileum were taken out and ligated into 5 to 6 cm segments, with 1 cm between each segment. Into each segment, 1 ml of the assay sample was injected. Then the intestines were replaced, and the peritoneum sutured. Sixteen hours later, the peritoneum was reopened and the amount of fluid retained in each segment was checked. An accumulation of fluid equal to or greater than 1.0 ml per cm of intestine segment was a positive reaction meaning that the bacteria strain was able to produce enterotoxin.

3. Assay of toxin antigens. Bacterial Colony in situ radiation immunization was done in accordance with the Kemp method<sup>[7]</sup>.

## Conclusion and Discussion

### (a) Construction of Recombinant Plasmid pMM-CTII

In the recombinant plasmid pMM-CTII containing the CT toxin gene, there is a specific location for XbaI. In the digestion of XbaI, cut out the initiator of the CT gene and the initiation signal ATG of the coded CTA subunit, and then use this location that has been cut with an enzyme to isolate the CT gene segment that has no initiator in the CT gene itself, back connecting it with the plasmid pUC18 that contains *E. coli* lactose initiator. The recombinant plasmid pMM-CTII that is constructed in this way possesses the CT gene sequence, yet it is unable to express biological activity.

After double digesting the pMM-CT recombinant plasmid and the pUC 18 plasmid by using XbaI and EcoRI according to plan as shown in Figure 1, the 2.4 kb digested fragment of pMM-CT isolated by agarose gel

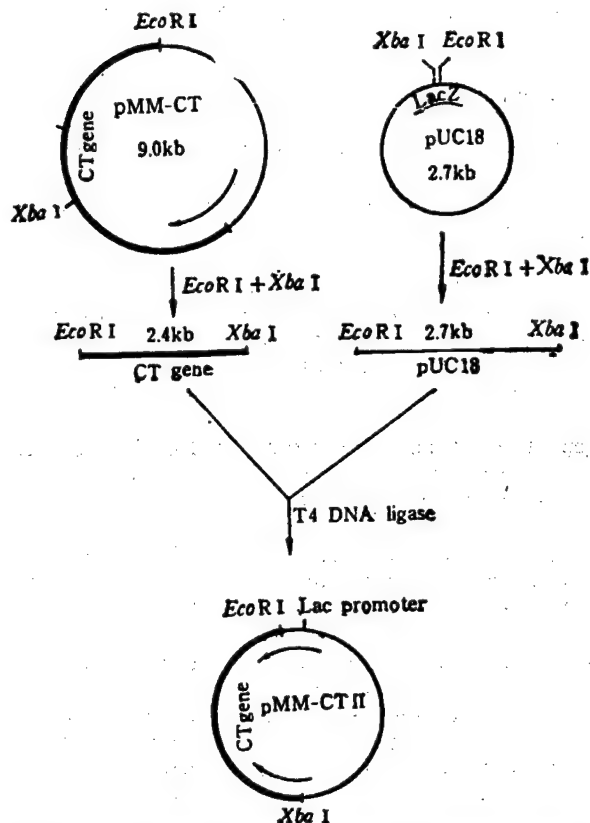


Figure 1. Construction of Recombinant Plasmid pMM-CTII

electrophoresis, and the 2.7 kb fragment of pUC18 were cleaned through electrophoresis to produce 500 ng each of phenol extract and ethanol precipitate. Eight hundred units of T 4 ligase was used in conditions for linking to carry out linkage and a transformation to *D. coli* RRI strain. Transformation was obtained from an ampicillin solid culture plate, a recombinant plasmid pMM-CTII clone being obtained as a result of colony in situ hybridization, recombinant plasmid agarose gel electrophoresis, and molecular hybridization assay. The cell culturing liquid from this cloned strain as well as the cell pyrogenetic fluid was verified as being without toxic expression through rabbit intestines ligation testing and  $Y_1$  cell measurement.

## (2) Preparation of CT Gene Probe and Assay of O 1 and Non-O 1 group *V. Cholerae*

The isolated and purified recombinant plasmid pMM-CTII is double digested using XbaI and EcoRI, and through gel electrophoresis to prepare a 2.4 kb segment containing a CT gene. [ $\alpha$ - $^{32}$ P] dATP is used in labeling using the nick translation technique, with radiation specific strength reaching as much as  $5 \times 10^7$  cpm/ $\mu$ g DNA.

This probe is used for the assaying of the O 1 colonies and non-O 1 colonies of *v. cholerae* in hybridization conditions consisting of 50 percent formamide at 42 degrees C for hybridizing overnight. From the results it is clear that the O 1 colonies produced a toxic strain no matter whether from the classical form or the Eltor biological form, and no matter whether the rice leaf form or the Ogawa [1420 1557] form blood serum form. All showed black imprints, and results were identical with those obtained from the application of the immune probe in carrying out in situ solid phase radiation immunoanalysis (from which data has not yet been collated and will be presented in a separate article). This demonstrates strong specificity for the gene probe and that it is useful in assaying cholera toxin genes.

## (3) Assay of *V. Cholerae* Strains Isolated From Clinical Specimens and From the External Environment

Assaying was done on the 102 strain of the *v. cholerae* virus that had been isolated from clinical specimens and from the external environment. Typing of bacteriophages showed 52 strains as being epidemic strains and 50 as being resistant strains. Assay results showed 48 of the 52 epidemic strains as possessing toxic genes. This was 92 percent of the assayed strains. Assay of the 50 resistant strains showed eight strains, or 16 percent, has having the CT gene. This demonstrates that use of bacteriophage classification is a fairly crude way of differentiating toxin producing and non-toxin producing *v. cholerae*. Toxic gene prope analysis is both more accurate and more reliable than bacteriophage classification.

The foregoing results show that the CT gene clone strain that we constructed successfully produces no toxin and that CT gene DNA can be used conveniently to make a gene probe that can be used in the assaying of toxin-producing strains of *v. cholerae*. The main advantage of this assay is direct assaying of toxin genes, assay results being accurate and reliable. Positive indicates the presence of a toxic strain; negative indicates no toxic strains. In addition, there is no interference from other contaminated hybrid germs and cell toxins. The toxin gene probe assay is  $10^4$  more sensitive than the  $Y_1$  adrenal gland cell. Not only may it be used in testing and diagnosis, but it is also an extraordinarily effective tool in epidemiological investigations.<sup>9</sup>

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**Complement-Mediated Solubilization of Immune Complex in Patients With Epidemic Hemorrhagic Fever**

40091021c Beijing ZHONGHUA YIXUE ZAZHI [NATIONAL MEDICAL JOURNAL OF CHINA] in Chinese Vol 67 No 5, May 87 pp 250-252, 304

English abstract of article by Ni Chuanyuan [0242 0278 3293], et al., of Nanjing Railway Hospital]

[Text] Complement releasing activity (CRA) in patients with epidemic hemorrhagic fever (EHF) was found.

CRA of patients with EHF dropped significantly in the febrile phase, and it was the lowest in the hypotensive phase. As the patients' conditions improved, CRA became elevated. However, the patients' CRA still remained significantly lower in the convalescent phase than the normal level. there was no regular correlation between CRA and the results of various phases of CH<sub>50</sub>, APH<sub>50</sub>, C<sub>3</sub>, or C<sub>4</sub>. From a series of experimental results, the conclusion is as follows:

a) The CRA decrease plays a certain role in the EHF pathogenesis.

b) The CRA elevation in patients may promote recovery from the disease.

c) CRA has particular significance as a parameter to determine the function of the complement system.

9717/12223

**Quick, Reliable Enterotoxin Detection Method**

40081033a Beijing ZHONGHUA YIXUE JIANYAN ZAZHI [CHINESE JOURNAL OF MEDICAL LABORATORY TECHNOLOGY] in Chinese Vol 10 No 4, Jul 87 pp 232-233

[Article by Zhu Qingyi [2612 1987 5030], Huang Yuan-tong [7806 0337 2727] and Huang Lanlan [7806 5695 5695], Shanxi Province Cooperative Team For Scientific Research on the Control of Diarrhea in Children, and Chen Huizhu [7115 1979 3796] and Yang Zhengshi [2799 2973 2514], Chinese Pharmaceuticals and Biologicals Rating Institute: "Rapid Detection of E. Coli Heat-Labile Enterotoxin by Co-Agglutination"]]

[Text] Absract: Staphylococci protein A (SPA) and rabbit anti-human E. Coli heat-labile enterotoxin immunoserum (anti-HLT) were used to make a diagnostic reagent for detecting E. Coli LT enterotoxin in a co-agglutination assay (COA). A plate hemolysis assay served as a control. In addition, 11 strains of toxin producing and non-toxin producing strains, and 64 strains of E. Coli kept in the laboratory were examined

for completely consistent results. These two methods were used to examine 150 strains of newly isolated E. Coli, the COA showing positive for 60 strains as a result of five of the strains having hemolytically active E. Coli. In the plate hemolysis assay, hemolytic interference made it impossible to obtain results. Consequently, in the plate method, only 55 strains showed positive. In the COA method, the positive detection rate was 3.33 percent higher than the plate method. Use of the COA method for detecting E. Coli LT enterotoxins is simple, requires no special apparatus, is specific, sensitive, and low in cost. It is suitable for promotion for use by grassroots level medical units.

The Co-agglutination Assay (COA) detection of E. Coli heat-labile enterotoxins (LT) uses staphylococci A protein (SPA) as a vector in combination with specific rabbit anti-human LT (anti-HLT) Ig G in the Fc stage as a diagnostic reagent for detecting E. coli LT enterotoxins. This article reports the application of the COA method to 225 strains of E. coli and to 53 other enteric pathogens to detect LT. A plate immuno hemolysis assay was used for comparison. Results are reported below.

**Materials and Methods**

1. Bacteria: Nine strains of standard ETEC, and two strains of non-ETEC. The laboratory keeps 64 strains of toxin producing and non-toxin producing bacteria (that have been evaluated by the Shanghai Municipal Station and the Beijing Rating Institute). The hospital has 150 newly isolated strains of E.Coli from children suffering from dysentery, for a total of 225 different strains of E. Coli and 53 strains of other enteric pathogens.

2. Freeze dried SPA thallus reagent: Supplied by the Shanghai Biological Products Research Institute

3. Anti-HLT serum: Supplied by the Chinese Pharmaceutical and Biologicals Rating Institute

4. SPA anti-HLT diagnostic reagent preparation: To 1 part freeze dried SPA thallus, add 1 part distilled water to make 1 ml of solution (10 percent bacteria solution). Add anti-HLT at a ratio of 1:10 to make 1 ml of diluted serum. Mix thoroughly and place in a 37 degree C water bath for 1 hour shaking normally. Remove when the time is up and centrifuge at 3,000 rpm for 5 minutes to separate the precipitate. Use 0.01 m of PBS at a pH of 7.4 to wash the precipitate twice. Then add 2 ml of NaN<sub>3</sub>-PBS-BTG (0.01M pH 7.0 PBS 100 ml, 0.5 g of ox blood serum albumin, twain 80 0.05 ml, white gelatin 0.01 g, NaN<sub>3</sub> 0.02g) to make a 5 percent diagnostic bacteria solution. Keep at 4 degrees C for use.

5. Entertoxin preparation. Inoculate a toxin producing plate culturing medium with the thallus, growing between 12 and 16 specimens on each plate for between 18 and 24 hours at 37 degrees C. Scrape off the lawn and put a small amount into a 30 µl polymyxin B solution (20,000 U/ml) small plastic tube and place in a 37 degree

C water bath for 30 minutes. Centrifuge to precipitate, and remove the supernate for use in the co-agglutination assay. Alternatively, the lawn may be scraped directly from a Chinese blue or maikangkai [7796 1660 0418] culture medium to prepare an enterotoxin reagent.

6. Glass slide co-agglutination assay. Add 1 drop (about 10  $\mu$ l) of SPA diagnostic bacteria solution and 1 drop (about 10  $\mu$ l) of the enterotoxin solution to be tested to a glass plate and mix gently. Keep at room temperature for between 5 and 10 minutes, and observe the results. Use an unmarked antibody SPA bacteria solution and physiological saline as a negative control, recording individual results with a -, +, ++, or a +++. Those with a co-agglutination strength of ++ or more show a positive reaction.

7. Plate immunohemolysis assay is done using the Yang Zhengshi method<sup>(1)</sup>.

#### Results

1. For results of the COA method and the plate method of detection on 225 strains of E. Coli, please see the attached table. Results derived from both detection methods were completely identical and reactions accurate for nine strains of standard ETEC, two strains of ETEC, and 64 strains of E. coli kept on hand. For five of the E. Coli strains kept on hand, negative readings of LT+ or LT+ ST+ may have been due to the strains having lost their toxin producing granules as a result of having been kept on hand for a long time. Eight of the 150 strains of newly isolated E. Coli showed hemolytic activity, and in the plate method no results could be obtained because of the hemolysis. The COA method detected LT+ in five of these strains. Consequently, the positive rate from the COA method was 3.33 percent higher than from the plate method. Those that tested positive by the COA method also tested positive by the plate method. In no case did the specimens examined by the COA method produce a false positive or false negative reading.

2. Results from LT testing of other enterobacilli. Testing was done on 53 strains of other bacteria including 24 strains of shigella, seven strains of salmonella, two strains of pneumonia Krebs bacteria, 16 strains of proteus, two strains of Pseudomonas aeruginosa, and two strains of enterocolitis yersinia. Both the COA method and the plate method were used to test for LT+, identical results being obtained.

#### Discussion

Either biological methods or serological methods may be used to test for LT enterotoxins in E. coli, but special equipment and complex technical operations are required in most cases. Though plate immunohemolysis assay is a straightforward method that is sensitive, specific, and for which results are reliable. Nevertheless, it requires fresh guinea pig blood serum and red cells

附表 225株大肠杆菌两种方法检测结果

1 菌株	2 肠毒素	3 菌株数	4 COA法 LT+ 数	5 平板法 LT+ 数
6 标准ETEC	TL+	4	4	4
	LT+ ST+	2	2	2
	ST+	3	0	0
7 非ETEC 保存大肠 杆菌	TOX-	2	0	0
	LT+	20	17	17
	LT+ ST+	9	7	7
	ST+	7	0	0
	TOX-	28	0	0
8 新分离大 肠杆菌	未知 9	150	60	55

Table: Results of Testing 225 Strains of Enterobacilli Using Two Different Methods

Key: 1. Bacteria strain 2. Enterotoxin 3. Number of strains 4. Plate method LT plus count 5. COA method LT plus count 6. Standard ETEC 7. Non ETEC E. coli kept 8. Newly isolated E. coli 9. Unknown

from sheep, making it unsuitable for promotion at the grassroots level. Brill et al used the COA method to test for E. Coli LT enterotoxins<sup>(2,3)</sup> for which no special equipment was needed and the method was straightforward. Using SPA diagnostic reagent that one can prepare oneself, the COA method was applied to the testing for LT of 225 strains of E. coli and 53 strains of other enterobacilli, with the plate method being used for control purposes. This demonstrated that the COA method possesses fine sensitivity and specificity. Testing of hemolytically active E. Coli for LT could also be done without restriction and without the hemolysis effects of the plate method. In this regard, the COA method is superior to the plate hemolysis assay method. Practice has demonstrated the COA method without an agglutination reaction when used on other enterobacilli. Operations are simple, sensitive, and fast; specificity is high, and costs are low, suiting this method particularly well to promotion for use by grassroots treatment units.

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### **Monoclonal Antibody for Hepatitis B Virus Developed**

40081029a Beijing ZHONGGUO YIXUE LUNTAN  
BAO [CHINA MEDICAL TRIBUNE] in Chinese  
15 Aug 87 p 8

[Article by Xia Mengqi [1115 1322 3825]: "Development and Application of Monoclonal Anti-PreS<sub>2</sub>"]

[Text] The Hepatitis Institute of Beijing Medical College used poly-human serum albumin [PHSA] recipient negative hepatitis B virus (HBV) granulation-sensitive pathogenic BALB/C mouse spleen and myeloma (SP 2/O) to do cell fusion, obtaining a strain of monoclonal antibody cell strains (2E<sub>2</sub>) that are able to inhibit PHSA recipient potency. An evaluation made in April 1987 with the help of the Tokyo Immunity Reagent Institute in Japan confirmed this to be specific for PreS<sub>2</sub> on HBV. The immunoglobulin type is IgG<sub>1</sub>. This cell strain possesses stable, high titer antibody secretion capabilities, the first such reported in China. Use of this monoclonal antibody-prepared blood cell and PHSA blood cell is fairly straightforward. Results of the two show a direct interrelationship. Because of the specificity of the anti-PreS<sub>2</sub> for the HBV, false positives for PHSA blood cells occasioned by the HBV factor may be eliminated. In tests for PreS<sub>2</sub> antigens, specificity was superior to that of PHSA blood cells. A comparison of HBV-sensitive serological indicators shows the following: The mean coagulation titer for PreS<sub>2</sub> is higher in HBeAg positive blood than in HBeAg negative blood serum. In HBeAg negative blood, the PreS<sub>2</sub> titer and the HBsAg titer form a direct relationship; however, there is no marked parallel relationship with the HBeAg titer. This suggests that even though both the PreS<sub>2</sub> and the HBeAg may evidence the competency of the virus to replicate, since the paths produced by the two differ and since there is no parallel relationship between titers, they are not entirely interchangeable.

In recent years, the role of PreS<sub>2</sub> antigens in pathogeny and in neutralizing immunoinduction, in virus replication, and in judging the level of transcription, as well as in studies to estimate post-prognosis significance has aroused widespread serious attention in both China and abroad. The production of monoclonal anti-PreS<sub>2</sub> will provide a powerful tool for thoroughgoing study of these antigens.

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### **Fetal Thymus Gland Cells Used To Treat Pulmonary Tuberculosis**

40081029b Beijing ZHONGGUO YIXUE LUNTAN  
BAO [CHINA MEDICAL TRIBUNE] in Chinese  
15 Sep 87 p 2

[Article by Han Fugang [7281 4395 0474]: "Fetal Thymus Cells For Treatment of Pulmonary Tuberculosis"]

[Text] The No 309 PLA Hospital's blood laboratory, in cooperation with the Tuberculosis Section, has used fetal thymus cells for the first time in the treatment of

pulmonary tuberculosis. The fetus was delivered in mid-term by a healthy pregnant woman suffering from a hygroma. The thymus cells were injected together with drugs into 10 patients seriously ill with pulmonary tuberculosis (the therapy group); another 8 patients in the same stage of the disease (the control group) were treated only with drugs for comparison.

Most of the pulmonary tuberculosis patients exhibited depressed cell immunity. Patients suffering from chronic fibrous cavernous pulmonary tuberculosis, in particular, had lingered for a long time, and results from therapy had not been satisfactory. The use within China of fetal thymus gland tissue transplants to treat patients having defective primordial thymus gland development had markedly increased immunity and ability to ward off infections. Encouraged by these results, the hospital used injections of fetal thymus gland cells to treat pulmonary tuberculosis patients, each injection of fetal thymus gland cells being  $2 \times 10^8$  -  $1 \times 10^9$ , a total of two injections being given at between 10 and 14 day intervals. After injection of the therapeutic tissue, symptoms, physical strength, self-perception, and weight increase were all markedly superior to that of the control group. The therapy group's E-rosette combining rate and lymphocyte conversion rate were between 10 and 20 percent higher than before injection, and this continued for 2 months. Gamma reactive proteins and density of anti-tuberculosis bacillus antibodies in the blood serum were both lower than before the injections. In the control group, the aforementioned immunity indicators remained at the same level as before therapy. Chest X-rays of the therapeutic group were taken 1 month later. These showed marked absorption of nidi in four patients, and the closing of a cavern in one patient. Tuberculous germs in the sputum of six patients showed negative. X-rays of the control group showed, however, the absorption of nidi in only one patient, and negative tuberculosis germs in the sputum of one patient. Seventy patients have been clinically treated with injections without any side effects.

The fetal thymus gland is the central immunological organ in fetuses. It contains thymus gland cells made up of mature thymus gland cells and many kinds of thymus polypeptides. When injected into the body, it can increase the organism's immunity, thereby increasing therapeutic results against tuberculosis.

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### **Effect of Endogenous GABA Receptor Inhibitor on Rat Blood Pressure**

40081020c Beijing YAOLIXUE YU DULIXUE ZAZHI  
[CHINESE JOURNAL OF PHARMACOLOGY AND  
TOXICOLOGY] in Chinese Vol 1 No 4, Aug 87 p 282

[Article by Cai Ningsheng [5591 3942 3932] and Zhou Tingchang [0719 1694 0394] of the Institute of Basic Medicine, Chinese Academy of Medical Sciences; and Xiao Wenbin [5135 2429 1755], Institute of Pharmacology and Toxicology]



[Abstract] An endogenous gamma-aminobutyric acid receptor inhibitor (GABA-RI) was isolated and purified from bovine cerebellum in 1985 in the authors' laboratory. In the preliminary analysis, GABA-RI is a peptide with molecular weight less than 6,000. The authors injected into (rat) cerebral vesicle (icv) 400 ug of GABA receptor stimulant GABA and 1 ug muscarinol to lower the blood pressure by 30 mm Hg. With (icv) 2 ug GABA receptor antagonist, an alkaline extract of *dicentra spectabilis*, the blood pressure was elevated by 70 mm Hg. With 250 ug GABA-RI, the blood pressure in rats can be elevated; at 1,500 ug, the same range of elevation in blood pressure as the alkaline extract of *dicentra spectabilis* can be induced. This blood-pressure elevating function of GABA-RI has a clear-cut relation corresponding to its dosages. The blood-pressure elevating effect with GABA-RI (icv) can be antagonistic by the previous administered muscarinol (icv). Under the same conditions, however, previous icv into brain center of the alpha adrenaline receptor stimulant, clonidine, renders this function nonantagonistic. Conversely, the previous icv of endogenous GABA-RI also can be antagonistic to the lethal function of blood-pressure drop with 3 ug muscarinol, but cannot be antagonistic to the pressure-drop function of the brain center due to clonidine.

The foregoing shows that GABA-RI (extracted from bovine cerebellum) has a function similar to the alkaline extract of *dicentra spectabilis* with respect to blood pressure during anesthesia in rats. This is probably because of its siting in the same synapses as for muscarinol, but not related to the alpha adrenaline receptor. This result is consistent with the competitive inhibition and uniqueness exhibited in an in vitro experiment of combination with radioactive-labelled gametocytes.

10424/12913

#### **Effect of Sodium Artesunate on Six Isolates of Plasmodium Falciparum in Vitro**

40081020a Beijing YAOLIXUE YU DULIXUE ZAZHI [CHINESE JOURNAL OF PHARMACOLOGY AND TOXICOLOGY] in Chinese Vol 1 No 4, Aug 87 pp 283-286

[Article by Huang Jiazhang [7806 1376 4545] and Gao Xusheng [7559 1776 2932] of the Institute of Microbiology and Epidemiology, Academy of Military Medical Sciences, Beijing 100850; and Ren Na [0117 1226] of the Traditional Chinese Drug Institute, Beijing Academy of Traditional Chinese Medical Sciences]

[Abstract] The effect of sodium artesunate on six isolates of *Plasmodium falciparum* was studied in vitro. The results showed that all the isolates (including anti-chloroquine isolates) were sensitive to sodium artesunate; no difference between chloroquine-sensitive and chloroquine-resistant strains was observed. As compared with five other drugs (for example, chloroquine, quinine, piperazine and pyrimethamine), sodium artesunate

concentrations for inhibiting maturation of *P. falciparum* Schizont and for killing it were the lowest. The total inhibiting and killing concentrations were 0.018 uM and 0.063 uM, respectively; and the concentrations needed for 50 percent and 90 percent reduction of parasite count in culture ( $IC_{50}$  and  $IC_{90}$ ) were 0.0013-0.0029 uM and 0.0071-0.0098 uM, respectively.

Three tables show the effects of sodium artesunate (s. a.) and other drugs on the maturation of *Plasmodium falciparum* (P. f.) Schizont and P. f. in vitro; and  $IC_{50}$  and  $IC_{90}$  of s. a. and other drugs on P. f. in vitro. The first draft was received on 8 July 1986; the final, revised draft was received for publication on 21 January 1987.

10424/12913

#### **Involvement of Noradrenaline and Endorphin Systems in the Anxiogenic Action of Benzodiazepine Receptor Inverse Agonist** 40081020d Beijing YAOLIXUE YU DULIXUE ZAZHI [CHINESE JOURNAL OF PHARMACOLOGY AND TOXICOLOGY] in Chinese Vol 1 No 4, Aug 87 p 292

[Article by Yang Xiaomin [2799 2556 2404], Luo Zhipu [5012 6347 3877] and Zhou Jinhuan [0719 6855 7806] of Institute of Pharmacology and Toxicology, Academy of Military Medical Sciences, Beijing 100850]

[Abstract] There is still no full elucidation of the mechanism of inducing anxiogenic action after a noradrenaline molecule is occupied by an inverse agonist. In this article, a behavior conflict procedure employing a conditioned reflex device and electric shock was applied to rats. For the first time, the authors observed that noradrenaline and endorphin jointly cause the anxiogenic action of the benzodiazepine receptor inverse agonist DMCM.

According to experimental requirements, several units can be conceptualized in behavior conflict procedure of electric shock; each unit is composed of a period with and a period without behavior conflict. These two periods have durations of 3 and 5 minutes, respectively, for the training and intensification stages. On the experimental days, these periods are 10 and 5 minutes, respectively. In the two periods, the operation procedures are denoted, respectively, as  $FR_2$  and  $FR_4$ . In the conflict period, each time a rat completes an  $FR_2$  operation, an electric shock of 0.5 mA is applied to the rat thus preventing realization of the intensification, thereby constituting a behavior conflict and simulating anxiogenic state.

From the experimental results, after DMCM occupies a benzodiazepine molecule, the function of GABA [gamma-aminobutyric acid] system is inhibited, thus reducing the GABA function and leading to hyperfunctioning of endorphin system; this potentiates the noradrenaline system and leads to anxiety.



The paper was received for publication on 22 June 1987.

10424/12913

**Pathomorphological Observations of T2 Toxin Toxicosis in Rats**

40081020b Beijing YAOLIXUE YU DULIXUE ZAZHI [CHINESE JOURNAL OF PHARMACOLOGY AND TOXICOLOGY] in Chinese  
Vol 1 No 4, Aug 87 pp 307-312

[Article by Zheng Deqi [6774 1795 3825], Shen Juying [3088 5468 5391] and Liu Baoyun [0491 1405 0061] of the Institute of Pharmacology and Toxicology, Academy of Military Medical Sciences, Beijing 100850]

[Abstract] A total of 105 rats were given T2 toxin 0.6-0.9 mg/kg sc. More than 50 percent of the animals died within 20 hours after intoxication; thereafter, death occurred rarely. At necropsy, the major gross changes in 26 rats killed 6 hours after receiving sc T2 0.6-2.4 mg/kg were hemorrhagic in the small intestine and spleen, and atrophy of the thymus. Histopathological observation revealed radiomimetic damage in intestinal mucosa, lymphoid organs, hematopoietic tissue and testicular spermatogenic tissue. The features of T2-induced lesion were as follows: digestive tract lesion occurred early and was repaired rapidly; bone marrow lesion may be associated with the proliferation of bone tissue; testes lesion involved not only the seminiferous tubules but also the interstitial tissue; hepatic cell injuries may be observed within 24 hours after intoxication.

Five figures show the effect of T2 on body weight in rats, histopathological changes in rats given T2, and erythrocyte, circulating platelet and leukocyte counts in the blood of rats after receiving sc T2. Two tables show changes in serum biochemistry in rats after receiving sc T2.

The authors are grateful to professors Liu Xuotong [0491 7185 2717] and Xu Xiaoshan [6079 1420 3790] for revising the paper, to colleague Yang Yi [2799 1837] for sectioning slices for observation under the electron microscope, and to colleague Shen Qiedi [3088 0139 1717] for assisting in the biochemical determination. The first draft was received on 3 January 1987; the final, revised draft was received for publication on 2 March 1987.

10424/12913

**Chinese Herbal Medicine to Cure Chronic Hepatitis Found**

40081021c Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 25 Sep 87 p 1

[Text] Reported by journalist Zhang Tianding [1728 1131 1353] and correspondent Li Deyuan [2621 1795 0955]—Recently, Doctor Luo Guojun [5012 0948 6874] of the Shanxi Institute of Traditional Chinese Medicine

has developed a new pharmaceutical preparation "Yi-Gan-Tang" [0044 5139 3282]—a decoction for curing chronic type B hepatitis. Clinical practice for 55 patients showed that its cure rate reached 92.7 percent.

This "Yi-Gan-Tang" consists of Chinese herbal medicine Chaihu (*Bupleurum chinense*), Huangqi (*Scutellaria baicalensis*), Baihuashe Shecao (*Agkistrodon acutus*), Banlameng (*Isatis indigotica* or *Isatis tinctoria*), Yinchen (*Artemisia capillaris*), Shanyao (Chinese yam), Nuzhenzi (*Ligustrum lucidum*) etc. Its function is shugan (dredging the liver), lidan (benefiting the gallbladder), jiedu (detoxification), jiangmei (lowering serum transaminase), zishen (nourishing the kidney) and strengthening and regulating the immune function. The results of clinical practice on 55 chronic type B hepatitis patients indicated that 34 patients got short-term cure (61.8 percent), 17 patients improved (30.9 percent), and the other four patients registered no change (7.3 percent).

The course of chronic type B hepatitis is long and has become one of the chronic diseases most harmful to health in China. Based on pathological theory of traditional Chinese medicine Luo Guojun considers penetration of duxie (toxicant) into the liver and gallbladder as the major cause of disease and shenxu (weak kidney) as the important step and final result of type B hepatitis. Therefore he aims at bingdu (toxicant) in pathogeny and at shenxu in pathology. Satisfactory results were achieved when two measures, jiedu (detoxification) zishen (nourishing the kidney), and quxie (driving the evil away) fuzheng (sustaining vital energy) were taken simultaneously.

12867/9738

**Chinese Traditional Medicine to Treat Second-Degree Burns**

40081021b Beijing GUANGMING RIBAO in Chinese  
26 Aug 87 p 1

[Article: "Chinese Wet Exposure Treatment for Deep Second-Degree Burns Without Skin Graft and Scars; Notable Results From Treatment of 470 Inpatients and Over 1000 Outpatients"]

[Text] Reported by GUANGMING RIBAO journalist Li Jiajie [2621 1367 2638] and XINHUA journalist Zou Peiyan [6760 3099 7346]: Chinese doctors have developed a new treatment and a new Chinese traditional medicine preparation for deep second-degree burns. Use of this new method and preparation to treat burns resulted in no need for skin graft, no infection, and natural healing of the injured surface without scars.

This important achievement of medical research was obtained by Doctor Xu Rongxiang [1776 2837 4382] of the Beijing Clinical Center for Burns and Ulcers as a result of his 7-year effort.

The National Commission of Awards for Achievements in Science and Technology organized medical specialists to certify this wet exposure treatment and fluid extract for burns. They stated that the topic was new and the achievement creative. It is convenient for treating burn patients at home and could play an important role in treating burns during wartime.

Previously, commonly used methods such as binding, drying under exposure, etc., were unable to prevent dermal tissues from dying. Consequently, the injured surface usually developed from deep second-degree to deep third-degree. The severe pain from the injured surface is unavoidable. During treatment infection often occurs, and scars remain from deep second-degree burns after recovery. Sometimes ulcers form under the scars and the patients have to be re-hospitalized.

For the last several decades through investigation of microcirculation on injured surfaces, specialists have found that the misunderstanding of burns led to incorrect treatment which produced unsatisfactory results. In fact, tissue injured by burns are recoverable, and treatment should be carried out under prerequisite conditions which could help the injured tissue to recover. But doctors of modern medicine using classical treatment and preparation consider the damaged tissue as necrotic. Later, it was found that the damaged tissue recovers rapidly in a wet environment. Since the 1960's specialists started to look for a "wet environment", but nothing came of it.

From Chinese traditional medicine Xu Rongxiang found a way to success. As indicated by theoretical Chinese traditional medicine, a body fluid environment is needed to cure burns. Referring to the modern scientific knowledge, Xu designed a new wet exposure treatment for burns. This treatment allows medicine to penetrate to the injured surface, so that the dead tissues can be removed through liquefaction and the damaged surface kept in contact with medicine all the time. The damaged surface is kept wet, but at the same time no extra liquid is present. The wounded surface is isolated from the atmosphere which keeps out infection. All these measures resolved the major problem which cannot be solved by treatment with modern medicine. Consequently, following the Chinese traditional medicine theories of *huoxue* (invigorating the circulation of blood) and *huayu* (dissolving the extravasated blood), *qufu* (removing the rotten tissues) and *shengji* (promoting the new tissues to grow), *qingre* (using medicines of cold nature to treat acute febrile diseases) and *jiedu* (detoxification) Dr. Xu reconstructed his own secret prescription from his ancestors and developed a new fluid extract for curing burns which can meet the need of his new treatment.

Up to 22 August, statistics indicated that 470 inpatients and over 1000 outpatients had accepted this new treatment and new preparation and excellent results were achieved. All the following patients were cured by this new treatment and new preparation and no scars

remained on their bodies: a young worker badly burned by alkaline, a woman worker with deep second-degree burns from a gasoline fire, a manager shocked with high-voltage electricity, a child scalded by boiling water. An 60-year-old worker from the Beijing Light Bulb Factory was hospitalized after being burned. The doctor bound him up for 4 days and on the injured surface large amounts of green pus appeared and the tissues were swollen and bleeding. His temperature was as high as 39.5 degrees C. The serum transaminase as an indication of liver function rose to 300 units. After that Xu Rongxiang used the new treatment and preparation to treat his burns. On the 11th day some new skin was growing on the damaged area. No scars remained after recovery.

12867/9738

#### **Preliminary Study of Monoclonal Antibodies for Hemorrhagic Fever**

40081034 Beijing JIEFANGJUN YIXUE ZAZHI  
[MEDICAL JOURNAL OF CHINESE PEOPLE'S  
LIBERATION ARMY] in Chinese  
Vol 12, No 4, Aug 87 pp 249-252

[Article by Cui Yunchang [1508 6663 2490], Zhu Yong [4281 0516] and Gao Lei [7559 4320] of the Department of Immunology, Fourth Military Medical College, An Xianlu [1344 3759 4389] and Zhen Rongfen [3917 2837 5358] of the Microbiology Department, Fourth Military Medical College and Ceng Yi [2582 3015] of the Virology Institute, Chinese Academy of Medical Sciences for Disease Prevention and Control: "Production and Characterization of Human Monoclonal Antibodies for Hemorrhagic Fever With Renal Syndrome Virus (HFRSV)"]

[Text] Abstract: The lymphocytes isolated from the blood of patients with hemorrhagic fever with renal syndrome in the convalescence phase were transformed by Epstein-Barr virus, then fused with the murine myeloma cell line X63-Ag8.653 and the heteromyeloma line SHM-D33. Two hybridoma lines, 86-1 and 86-2, were established, which produce IgM human monoclonal antibodies to hemorrhagic fever with renal syndrome virus at 30mg/mL and 50gigg/mL in the spent media, respectively. They have been producing antibodies stably for 7 months. Ascitic fluids rich in human monoclonal antibodies were prepared by injecting intraperitoneally the hybridoma cells into mice. If the serum in the culture is reduced by 2 percent, then there is no reduction of the antibody production. Key words: Hemorrhagic Fever with Renal Syndrome Virus (HFRSV) Human Monoclonal Antibodies Epstein-Barr Virus (EBV) Hybridoma

Since the introduction of the lymphocyte cell fusion or hybridization technique, monoclonal antibodies (mAb) have gained wide application in virology studies. Mouse mAb against hemorrhagic fever with renal syndrome virus (HFRSV) have been prepared in many domestic and foreign laboratories<sup>[1]</sup> since 1983. With help of these mAb, researchers were able to study the anti-genicity of

HFRSV as well as to screen, isolate and purify the antigens. However, mouse mAb are treated as foreign proteins by the human immune system, and their clinical use is severely limited. Thus, for diagnostic and therapeutic applications in humans, the production of human mAb would clearly be desirable. The procedure involved in the production of human mAb is much more complicated and difficult than that for murine mAb. To date, few attempts have been made in the production of human mAb for HFRSV. In this report, we would like to describe the production of human mAb against HFRSV by cell fusion of Epstein-Barr virus (EBV) transformed lymphocytes, isolated from peripheral blood of HFRS patients with the murine myeloma cell line and the heteromyeloma cell line. The results of our preliminary study on the two mAb are also presented here.

#### Materials and Methods

**Nutrient Broth.** The RPMI 1640 medium (Gibco Laboratories) containing 10% fetal calf serum (Gibco Laboratories), 2 mM glutamine and antibiotics was used as the standard nutrient broth. The nutrient broth for post-fusion cultivation is a modified standard nutrient broth with the fetal calf serum content increased to 20%, plus 5% NCTC-135 (Gibco Laboratories),  $1 \times 10^{-1}$  IU/mL insulin (Sigma) and 2-mercaptoethanol (Sigma),  $5 \times 10^{-5}$  M. After EBV-transformation, the cells were grown in the post-fusion medium with Cyclosporin A, 1  $\mu$ g/mL (Sandoz) added.

**Source of Lymphocytes.** Peripheral blood samples (10 ml), which gave positive test to HFRSV-antibodies assay, were collected from patients in the convalescence phase. The lymphocytes were separated from peripheral blood cells as previously described.<sup>[2]</sup> The B- and T-lymphocyte mixture was used directly for EBV-transformation.

**EBV-Transformation.** The B95-8 strain of EBV used for the transformation was kindly provided by Professor G. deThe of the Claude Bernard University, France. The lymphocyte cells were transformed as described.<sup>[3]</sup> The stimulated cells were cultured in 24-well plates (Linbro) at a concentration of  $1 \times 10^6$  cells/mL per well. The culture fluids were incubated for 10-14 days then assayed for antibodies.

**Cell Fusion.** Murine myeloma cell line X63-Ag8.653 and heteromyeloma cell line SHM-D33<sup>[4]</sup> were obtained from American Type Culture Collection, USA. Prior to fusion, the transformed lymphocytes were cultured in the standard broth and maintained in log phase growth. The lymphoblastoid cell line was then fused with X63-Ag8.653 and SHM-D33 cell lines, respectively, in 42

PEG (Fisher Scientific, MW 4,000) following the reported procedure.<sup>[5]</sup> After fusion, the cells were incubated in 96-well plates (Nunc). The fused cells were selected in HAT (Sigma) medium containing 0.5  $\mu$ M ouabain (Sigma). After 14 days, proliferating hybrids

were cultured in HT for another 7 days. Supernatant culture fluids were assayed for antibodies. All the wells exhibiting a positive test were cloned by limiting dilution.

**Assay for Antibodies.** (1) Assay for Nonspecific Human Immunoglobulin (Ig): 1. By the enzyme-linked immunosorbent assay (ELISA). Briefly, EIA 96-well trays (Linbro) were coated with goat anti-human IgM (Sigma, I 8633) or IgG (Sigma, A 8775). Culture supernatants were then incubated in the coated trays at 4°C for 18 h. Trays were washed phosphate-buffered saline containing 0.05

Tween 20 (PBS-T), layered with gelatin-PBS and kept at 4°C overnight. All the wells were then washed with PBS-T, and the supernatant to be assayed was added (50  $\mu$ L/well). Trays were kept at 37°C for 1 h and washed once more with PBS-T. Peroxidase-conjugated goat anti-human IgM (Sigma, A 6907) or IgG (Sigma, A 6209) was subsequently added and the culture incubated. After a final wash with PBS-T, trays were incubated with the indicator and their OD values determined. The primary standard of purified human IgM used in this study was provided by Dr. H. Wolf of the Pettenkofer Institute, West Germany. 2. Ouchterlony double diffusion assay: carried out using the reported procedure. (2) Assay for HFRSV-specific Antibodies: 1. The indirect immunofluorescent antibody test: A variant of HFRSV [possibly the Hantaan virus] infected Vero E6 cells were used to prepare antigen slides for the test. 2. ELISA for specific human Ig: EIA 96-well trays were similarly coated and prepared as described for the nonspecific ELISA. After the PBS-T washing, the HFRSV suspension, i.e., the virus-infected BHK cell culture medium, was introduced into the wells. Following incubation, trays were washed with PBS-T, then treated with peroxidase-conjugated murine mAb to HFRSV, C<sub>4</sub><sup>[1]</sup> and the incubation-washing process was repeated. The culture fluids were then incubated with the indicator. When no further change in color was observed, the OD values were determined and recorded. 3. Hemagglutination test: following the described procedure.<sup>[6]</sup>

**Large Scale Production of Human mAb.** NIH female nude mice, 8 weeks old, were inoculated with pristane intraperitoneally on days 1 and 7. On the 8th day, hybridoma cells ( $5 \times 10^6$  cells) were injected into the mice. Ascitic fluids were collected 3 weeks later.

**The Low-Serum Growth of Hybridoma Cells.** In order to minimize the protein-contamination in human mAb produced, the cells were grown in the standard nutrient broth containing an insulin-transferrin-selenium supplement (Sigma, I 1884) and the serum content of the medium was gradually lowered to 2%. After the hybridoma cells had adapted to this medium, the culture fluids were assayed for antibodies.

**Chromosome Analysis of Hybridoma Cells.** Chromosome preparations were made by standard procedures.<sup>[5]</sup>

Virus Study of Hybridoma Cells. (1) The detection of EB virus nuclear antigens (EBNA) was conducted following the reported procedure.<sup>[7]</sup> (2) HFRSV Test: 1. Hybridoma cell slides were assayed against high potency immunoserum of patients in the convalescence phase by the indirect immunofluorescent antibody test. 2. Hybridoma cells were frozen and thawed 3 times, then infected with Vero E6 virus to prepare HFRSV.

## Results

I. EBV-Transformation. Five days after infection with EBV, a proliferation of lymphoblastoid cells in all of the wells in a 24-well plate was observed. When assayed for HFRSV antibodies 10-14 days later, 100 percent of the wells tested positive.

II. Generation, Cloning and Stability of Hybridoma Cells. The fusion frequencies of the 2 cell fusions as well as the antibody responses of hybrids are shown in Table I.

Table 1. The Growth and Antibody Responses of Hybridoma Cells After Fusion

Cell Lines, Fusion Frequency	Nonspecified Human Ig Secretion <sup>gD</sup>		HFRSV Antibody <sup>gDgD</sup>			
	IgM	IgG				
Wells with Viable Hybrids* Hybrid Clones**						
X63-Ag8.653	100	2.1/10 <sup>5</sup>	100	39.6	5.2	0
SHM-D33	96.8	2.4/10 <sup>5</sup>	100	29.7	5.9	0

\*Percent of wells with viable hybrids; \*\* Number of clones per  $1 \times 10^5$  lymphoblastoid cells; gDPercent of wells with hybrids secreting nonspecific human Ig; gDgDPercent of wells with hybrids secreting specific HFRSV human antibodies

(1) X63-Ag8.653 Fusion Plates: One of the specific antibody-positive wells was selected and cloned. After the cloning, one of the monoclonal wells was selected and named 86-1 line, then recloned. One hundred percent of the wells from the second cloning were antibody positive. The growth of the 86-1 line was maintained in the standard nutrient broth, and the wells were assayed for antibody production every month. After 4 months in culture, the wells showed a significant fall in antibody production. Cloning for a third time showed that only 16.9

of the hybrid wells were secreting antibody. The 86.1 line was re-established from one of the subclones and grown in the standard medium. The antibody production returned to its original level, which has been maintained for 3 months.

(2) SHM-D33 Fusion Plates: In order to ensure that only single cells were selected, individual positive wells were examined under a high power lens. One of the monoclonal wells was cloned. All cloned wells, when assayed for antibodies, tested positive, indicating that the original clone was monoclonal. One of the subclones was selected as the 86-2 line and recloned. After the second cloning, all of the cloned wells were producing antibodies. The production level of the 86.2 line was unchanged 5 months later. The cloned cells were recloned for a second time, and 100 percent of the wells were producing

antibodies. This line has been stable for 7 months in continuous culture and no change in antibody production level has been observed.

III. Characterization of Hybridoma Cells. (1) Chromosome Analysis: Examination of 30 hybridoma cells from the 86.1 line revealed that the number of chromosomes ranges from 56 to 117 and has an average of 93. We detected chromosomes in the middle of the kinetochore in the human band and those in the kinetochore in the mouse band. Human chromosome 22 was identified in several of the cells. The X63-Ag8.653 cell has a model number of 49 chromosomes. (2) Virus Study: The 86-1 and 86-2 line slides were both EBNA positive and no HFRSV antigens had been detected. Test for HFRSV antibody was positive.

IV. Preparation of Ascitic Fluids. The maximum yield of 86.1 line ascitic fluids from a nude mouse was 11 mL and the average yield, 8 mL. As much as 5 mL of 86.2 line ascitic fluids had been collected from a single nude mouse, the average volume amounted to 2 mL. Growth of tumors was often observed in abdominal cavities.

V. The Antibody Production and Low-Serum Growth of Hybridoma Cells. Comparison of the results from ELISA with the standard curve of purified human IgM showed that the mean production levels of human IgM of the 86.1 and 86.2 lines per  $1 \times 10^6$  cells per 24 h were 30 gm/g and 50 gm/g respectively. Little change in antibody production was detected after the hybridoma cells had adapted themselves to the low-serum medium.

## VI. Preliminary Study on Human mAb

(1) The results of immunofluorescent antibody test of various strains of HFRSV and other viruses are tabulated in Table 2. Cell lines 86-1 and 86-2 gave similar responses to the test: both responded positively to virus strains

isolated from *Apodemus agrarius* and negatively to R22 and G9 strains from *Suncus murinus*. However, the two antibodies exhibited different fluorescence: the fluorescence of 86-1 line was derived from small particulates in the cytoplasm whereas that of the 86-2 line came from thicker and bigger particles in the cytoplasm.

Table 2. The Immunofluorescent Antibody Test Results of 86-1 and 86-2 Cell Line Human Antibodies Against Various Strains of HFRSV and Other Related Viruses

Human Antibodies	76118	Persistent Strain	HFRS Viruses						Western 4 Equine Encephalitis Virus	Other Viruses	
			A16	A9	14A	R22	G9*	A16*		Enteric	Echo
86-1		+	+	+	+	+	-	-	+	-	-
86-2		+	+	+	+	+	-	+	+	-	-

\* Section slides of infected mouse brains, others were fixed sides of Vero E6 virus infected cells.

(3) Human mAb Responses: See Table 3.

Table 3. Responses of Human mAb of Cell Lines 86-1 and 86-2

Human mAb	Immunofluorescent	Specific ELISA	Hemagglutination
86-1 Supernatant	1:4	1:64	1:8
Nude Mouse Ascitic Fluids	1:1,000	1:640	N/A
86-2 Supernatant	1:64	1:2,048	1:2
Nude Mouse Ascitic Fluids	1:2,000	1:60,000	N/A

(3) Ouchterlony Double Diffusion Assay: indicated that both 86-1 and 86-2 cell lines were IgMgl.

outgrowth of B lymphocytes,<sup>[9]</sup> instead of pre-eliminating T cells. At the same time, because of the patients' strong reaction to HFRSV, the enrichment process of B cells was saved as well.

## Discussion

The first cell fusions of EBV-transformed lymphocytes, isolated from peripheral blood of HFRS patients, with myeloma cell lines are reported in this paper. The two hybridoma cell lines thus obtained were capable of secreting human IgM mAb against HFRSV in good yields and have remained stable producers for over 7 months.

The production of human mAb has been hampered by technical obstacles. Transformation of human lymphocytes with EBV has had some successes,<sup>[8]</sup> but such cultures usually grow only very slowly, secrete low levels of antibodies and are very difficult to clone. Signs of clonal aging have also been observed in the cultures.<sup>[3]</sup> However, the fusion of EBV-transformed lymphocytes with myeloma cell lines generally produce rapid-growing, easy to clone and high-yielding hybridoma cells. In the EBV-transformation, a recognized limitation is the need to remove all the T cells and expand the numbers of antigen-specific B cells prior to transformation.<sup>[8]</sup> In this study, we treated the culture medium with Cyclosporin A after transformation to promote the spontaneous

The capacity of human x mouse hybridomas to secrete antibodies is often transient and human x human hybridomas are expected to be a more useful source of specific human mAb. However, studies have demonstrated that with early cloning, antibody production by human x mouse hybridomas was more stable than that of human x human hybridomas.<sup>[10]</sup> Our previous experiments using LICR LON /HMy2, UC-729-6, WI-L2-729-HF2 and GM1500 human cell lines as partners for cell fusion to prepare human x human hybridomas also showed that the yield of antibodies of hybrids thus generated, were too low and unstable for practical uses. (unpublished results). It was reported that the use of X63-Ag8.653 and SHM-D33 cell lines as fusion partners has consistently generated a high yield of viable hybrids.<sup>[5,11]</sup> Our study showed that fusion frequencies of these two cell lines were comparable (See table I). Yet, the hybridoma cells derived from fusion with SHM-D33 line give higher yields of antibodies and exhibit better stability. An independent investigation had shown that SHM-D33 fused hybrids are negative both to EBNA and to reverse transcriptase test. The human mAb they produced are generally more suitable for clinical applications. Loss of



chromosomes in interspecies hybridoma cells usually occurs within a few weeks of fusion. After several months, the karyotypes are already relatively stable. The 86-1 and 86-2 hybrids have been growing for more than 7 months and would appear to have a good chance of remaining unchanged.

The preliminary study of human mAb of 86-1 and 86-2 hybridoma cell lines is described here. Further investigation, as well as development for clinical application of these hybrids, is in progress.

(We wish to thank Dong Bangquan [5516 1620 2938] and Li Xiaolin [2621 1420 3781] of this department and Mi Li [4717 0500], graduate student of the 323rd Hospital for technical assistance. Clinical cases were provided by the Infectious Disease Departments of the First Hospital, the Second Hospital and the 323rd Hospital of the Fourth Military Medical College. We also wish to thank Professor Yan Yuchen [0917 3768 6591] of the Infectious Diseases Research Institute and Professors Song Gan [1345 1626] and Hang Changshou [2635 7022 1108] of the Virology Institute, Chinese Academy of Medical Sciences for Disease Prevention and Control for providing antigen slides and their help in characterizing antibodies and Professor Zhu Guanfu [4281 7070 4395] of the Academy of Military Medical Sciences, Comrade Liu Jiangqiu [0491 3068 4428] of the Military Medical Sciences Research Institute, Shenyang Military District and Director Ni Dashi [0242 1129 4258] of the Medical Sciences Institute of Anhui Province for their assistance in characterizing antibodies)

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12817/08309

## New Method Invented For Determining Endotoxin Concentration

40081029c Beijing GUANGMING RIBAO in Chinese  
14 Oct 87 p 2

[Article by Xia Rui [1115 5624]: "China Succeeds in Development of First Bacterial Endotoxin Detector"]

[Text] The Model XNC-1 Bacterial Endotoxin Detector and detection methods have surfaced in the Ji'nan Military Region's 155th Hospital. This is a new detector and a new method in the field of medicine and health for detecting bacterial endotoxins. It employs the patterns of quantitative changes in the concentration and bonding displayed by bacterial endotoxins, thereby changing from the qualitative examination to the quantitative examination stage the method whereby bacterial endotoxins are measured. This achievement earned a Merit Citation Third Class at the 1987 Armed Forces Medical Science and Technology Conference.

Bacterial endotoxins are toxins liberated by bacteria. Once food, drink or pharmaceuticals have been contaminated, high pressure sterilization is unable to eliminate the toxins, and when microscopic amounts of the toxins enter the human blood stream, serious reactions may be produced or life may even be threatened. In 1968, a noted American endotoxicologist, Professor Laiwen [phonetic] invented a trial-and-error reagent detection method that permitted only qualitative and semi-quantitative detection of bacterial endotoxins. The Ji'nan Military Region 155th Hospital director of the medical



equipment section and concurrently deputy pharmacist, Hu Guanshi [5170 0385 2514], used Professor Laiwan's trial-and-error reagent detection method for many years. He discovered that a certain pattern of quantitative changes existed between the bacterial endotoxin content and the jelling time required for the trial-and-error reagent, namely that the higher the endotoxin content, the shorter the jelling time required. In order to demonstrate this pattern further, in 1982 Hu Guanshi began to read large quantities of scientific data and to develop a bacterial endotoxin detector. He also summarized from a large volume of test data an empirical formula for the laws governing quantitative changes in bacterial endotoxins and the jelling time as follows:  $C = aTB$  ( $C$  being the concentration of the endotoxin,  $T$  being jelling time; and  $a$ , and  $b$  being the formula parameters for each batch of trial-and-error reagent). Use of this formula permits accurate measurement of the bacterial endotoxin content. The method is simple and practical. The technology for making the detectors is straightforward; the operating method is easy; operation is consistent, and the detectors possess fairly high ability to detect endotoxins.

9432

#### **Reconstructed Snake Toxin**

40081043a Beijing GUANGMING RIBAO in Chinese  
1 Dec 87 p 2

[Summary] A joint research team on cobra and silver krait venom led by Professor Mao Qingwu of the Research Institute of Preventive Medicine of the Chinese No. 2 Military Medical University, other scientists from the Pathology Institute, and Changhai Hospital, proved that new drugs derived from snake venom showed noticeable effects in motoneuron treatments. Molecules of cobra and silver krait poison were reconstructed chemically into nonvenomous neurotoxins which were then applied clinically in Changhai, Changzheng, and Baiqien hospitals on more than 400 patients suffering from motoneuron diseases, of the overall 60 percent cure rate, 24 percent showed noticeable recovery.

/9738

#### **Skin Graft For Large-Area Burns Said Successful** 40081021a Beijing RENMIN RIBAO [OVERSEAS EDITION] in Chinese 18 Oct 87 p 4

[Text] China is in a leading position in burn surgery in the world; particularly successful experience has been accumulated in the use of skin grafts to save patients with large-area burns. This message came from the First National Conference on Burn Surgery sponsored by the Chinese Medical Association and held in Shanghai recently.

According to a report in JIEFANG RIBAO, the total recovery rate of burn patients in China has reached 82-96 percent. Many county hospitals can now cure

patients with third-degree burns over 70 percent of the body area. In many medical institutions experience in saving the lives of burn patients involved in accidents has been accumulated and investigation of the particular nature of burns involving the elderly and infants has been carried out.

Covering of the burn area is the key link in saving the patient's life. Due to the shortage of autogenous skin, skin grafts become extremely difficult for patients with large-area burns. At the Beijing Jishui-Tan Hospital the so-called spreading graft is used to treat severe burn patients. The spreading rate of autogenous skin has reached ten to one. Overcoming the shortage of autogenous skin, this method plays an important role in saving patients with large-area burns.

In many hospitals rescue of patients with burns in specific areas, with special kinds of burns or with extraordinary deep burns has also been successful. Through early crust-cutting and skin-grafting for patients with localized burns such as the face, neck and hands, function and satisfactory looks can be restored after surgery. The course of pathological change is now understood for patients with electric shock and chemical burns and especially for the high death rate of patients with burns and inhalation of toxic chemicals. Through the use of bronchoscopy, the survival rate of such patients has been increasing.

12867/9738

#### **New Anti-Cancer Drugs Developed**

40081029f Beijing RENMIN RIBAO in Chinese  
28 Oct 87 p 3

[Article by Correspondent Yu Changhong [0060 7022 3163]: "Good Results From a Number of New Anti-Cancer Drugs That China Has Developed. China Substantially Able To Produce Effective Anti-Cancer Drugs In Common Use Internationally"]

[Text] Beijing Xinhuashe 27 October. Steady development of China's research on anti-cancer drugs is producing happy news for cancer patients, particularly cancer patients in the early stages of cancer. Reportedly a number of anti-cancer drugs developed by China itself have scored satisfactory therapeutic results in clinical treatment. China is also substantially able to produce and supply a number of effective anti-cancer drugs in common clinical use internationally, and China holds a leading position internationally in research on and synthesis of some drugs.

Anti-cancer drugs are effective in the clinical treatment of cancer. China has more than 30 years experience in anti-cancer drug research and production; however, formerly China produced many imitation drugs of poor effectiveness. As knowledge about cancer has deepened and as reform and opening to the outside world have

become more pervasive in recent years, China's anti-cancer research work has become alive and active, and a number new anti-cancer drugs of greater use in clinical treatment have been discovered, some of which have produced a wideranging international impact. The new anti-cancer drug, sanjianshanzhijian [0005 1423 2619 7927 4354], which was awarded a national Merit Citation First Class in 1985 for the advancement of national science and technology, is very effective in the treatment of non-lymphocytic anemia. The complete remission rate for treatment with this single medicine alone is 25 percent; when used in conjunction with chemotherapy, the remission rate rises to between 60 and 80 percent. Today it is being exported to many countries and regions. Maytansine is a new anti-cancer drug with an extraordinarily complex chemical structure, the complete synthesizing of which is extremely difficult. In 1985, China became the second country after the United States to be able to synthesize maytansine. This accomplishment marks China's entry into the front ranks of international anti-cancer research.

Past research placed undue emphasis on killing cancer cells, and did not sufficiently emphasize prevention. In recent years, China's anti-cancer drug researchers have opened new avenues of research, and have made definite progress in research on chemical prevention drugs and on cancer cell isolation and immunoinduction. Drugs like weianzhi [4850 5143 7927], weiansuan [4850 5143 6808], and weimeisu [4854 7199 4790] developed in China for the treatment of cancer of the esophagous, stomach cancer, and cancer of the cervix before they metastasize and to halt canceration have scored fairly good results. Research on the use of tumor-specific monoclonal antibodies and anti-cancer toxins, anti-cancer drugs, or isotopes in the interrelated preparation and trial use of "mini-missiles for medical use" is making progress. Trial use on liver cancer of positioning diagnosis and treatment have scored preliminary successes.

Serious attention to the exploration of Chinese herbal medicine treasures and vigorous development of plant medicines have been special features of China's anti-cancer drug research in recent years. Nor-canthalides amine, which has been developed and synthesized from anti-cancer insect folk medicine, has been used to treat 244 cases of liver cancer, proving effective in 58.6 percent of them without side effects such as suppression of bone marrow activity or stimulation of the urinary system. The use in pulmonary cancer and esophageal cancer radiation therapy of plant medicines such as Chinese small iris seeds [*Iris pallasii* var. *chinensis*] jiasu [3946 4790], and donglingcao [0392 0407 5430] jiasu [3946 4790] have scored fairly good clinical results.

#### **Anti-A and Anti-B Blood Type Monoclonal Antibodies Developed**

40081043c Beijing RENMIN RIBAO [OVERSEAS EDITION] in Chinese 6 Dec 87 p 1

[Summary] Because of the growing cost and diminished supply of standard anti-A and B human blood type sera, and with more people being screened, instead of using human standard anti-sera, scientists in Hebei have developed anti-A and anti-B monoclonal antibodies, which have proven to be better than human standard anti-sera. The Basic Medical Research Institute of Hebei Medical College has isolated six strains of specific anti-A and anti-B monoclonal antibodies from more than 10,000 clones. The ascitic fluid produced by injecting the cell strains into mice has been tested and proven to be highly specific.

/9738

#### **Starfish Plasma Substitute Found**

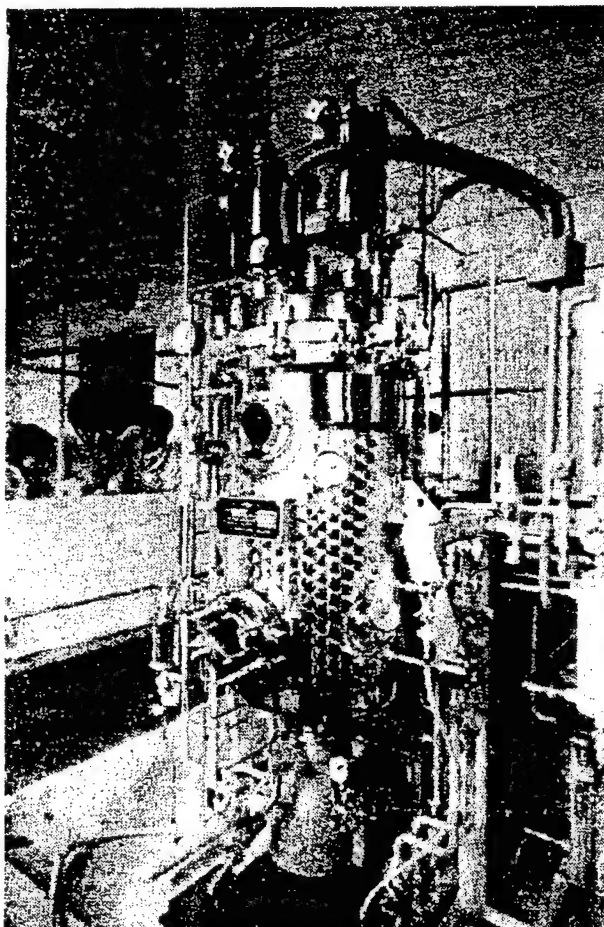
40081043b Beijing RENMIN RIBAO [OVERSEAS EDITION] in Chinese 6 Dec 87 p 2

[Excerpt] The concept of extracting starfish gelatin started in 1977 when Zhang Xinjiang of the PLA No. 404 Naval Hospital first noticed that a gel-like substance secreted by starfishes dissolved the hard shells of mollusks. In April 1978, he started batch production of the gelatin to be tested in military hospital and other organizations, including the Second and Third Research Institutes of Military Academy of Medical Sciences, Changzheng Hospital, and Institute of Biological Research of the Second Military Medical University, where tests indicated that many physical properties of starfish plasma-substitute gelatin were similar to those of human plasma in molecular weight, solubility, melting point, heat-stability. The tests also proved that the gelatin was non-toxic, non-accumulative, non-antigenic to animals, and was not harmful to their livers. Since the gelatin came from living organisms, it had the advantages of being easily broken down into simple, easily absorbed amino acids by enzymes in the body and easily metabolized by the body. Since plasma and plasma substitutes are important to the military both in war-times and peacetime, the discovery is of great value academically and technologically, and is especially valuable for blood transfusions in these days of AIDS phobia. More research work on the gelatin is being done.

/9738

#### **Gene Engineering Interferon Put into Medium-Scale Production**

40081043d Beijing RENMIN RIBAO [OVERSEAS EDITION] in Chinese 19 Dec 87 p 4



A new method of producing more productive, less expensive interferon for viral hepatitis treatment has been developed by a joint research team of the Shanghai Biological Products Research Institute and the Viral Research Institute of the Academy of Preventive Medical Sciences and is being put into medium-scale production to replace the tradition extraction method of producing less productive, more expensive interferon from human blood. Photograph shows scientists conducting gene engineering interferon tests in the laboratory.

/9738

**Space Environment Changes in Living Organisms**  
40081028 Beijing RENMIN RIBAO [OVERSEAS EDITION] in Chinese 11 Nov 87 p 4

[Summary] Test results on nearly 70 plant conducted specimens by the Chinese Academy of Sciences in two retrieved satellites revealed that conditions of space radiation and reduced gravity did cause variations on plant growth. The scientists studied the morphology, cytology and genetics of many kinds of seed, callus tissues, cell strains, and bacteria species from the recovered satellites, concluding that the space environment obviously accelerated or inhibited growth in some plants, insects, and microorganisms, increased germination rates; promoted blooming and earing of some plant

seeds such as cucumber, Chinese pine, tomato, green pepper, barley, wheat, and corn; and improved resistance to insect attack. However, some plants showed signs of slower germination rates, weaker root systems, and lowered fruit yield.

/06091

#### **Use of Snake Venom in Treatment of Vascular Disease Highlighted**

40081029e Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 30 Sep 87 p 2

[Article by Xing Zhongfa [6717 1813 4099]: "China's Snake Venom Research Enters Production and Therapeutic Application Phase. PLA 238th Hospital Establishes Pallas Pit Viper Raising, Pharmaceutical Manufacture, and Clinical Application System"

[Text] Shenyang Military Region's 238th Hospital, renowned throughout the country for the treatment with snake venom of blocked blood vessel diseases, has attained an advanced level for China in the clinical application of its Changbaishan terrestrial Pallas pit viper toxicology research following 6 years of efforts. This hospital has become China's first unit to apply snake venom research to the "three-in-one" raising of snakes, making of pharmaceuticals, and clinical application of snake venom.

The extraction of a highly effective substance from snake venom is a topic currently being given generally serious attention by scientific workers both in China and abroad. Chemical analysis shows snake venom to contain 18 different components of extremely high value for medicinal use. Snake venom is 20 times more valuable than gold in international markets. The PLA 238th Hospital has relied on the rich natural advantages with which the hospital area is endowed in setting up this research project for turning toxin into treasure. It has built a 2,200 square meter snake farm where it raises more than 32,000 Pallas pit vipers. It has also reproduced nearly 1,000 second generation Pallas pit vipers, and it has written a monograph titled, "Artificial Raising of the Northeast Terrestrial Pallas Pit Viper."

Since 1981, it has extracted more than 5,200 grams of snake venom from the mouths of snakes, and in 1984, it isolated the zymine, racemase, the main constituent of arginase, from the terrestrial Pallas pit vipers of Changbaishan in northeast China for the treatment of 20 different blocked blood vessel diseases, including vasculitis and cerebral thrombosis, for an effectiveness averaging more than 90 percent. This achievement earned the hospital a Merit Citation Second Class from the State Pharmaceutical Administration and for scientific and technical invention within the armed forces. The success of this project marks the passage of snake venom

research from the experimental stage into the stage of production and therapeutic application. It is at an advanced level for China. In addition, the 238th Hospital has applied racemase to clinical treatment, and has established technical cooperation with 62 hospitals in 16 different provinces or cities to form a network for the application of racemase to therapy. This is music to the ears of more than 28,000 patients. A monograph titled "The Clinical Application of Snake Venom Racemase" will also soon be issued.

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**Perfluorocarbon-based Blood Substitutes and Myocardial Protection**

40081012 Beijing BEIJING YIKE DAXUE XUEBAO  
[JOURNAL OF BEIJING MEDICAL UNIVERSITY]  
in Chinese Vol 19 No 4, Aug 87 pp 277-280

[Article by Sun Bing [1327 0393] and Wu Yijing [0124 6318 4842] of the Pathology and Physiology Laboratory, Beijing Medical University]

[Abstract] With the demonstration of the oxygen-carrying capability of perfluorocarbon (PFC) as indicated by the survival of mice which were completely immersed in a fluorocarbon liquid, a great deal of progress has been made in the development of perfluorocarbon-based (PFCE), complete with electrolytes and nutrients, have been developed and are commercially available for extracorporeal organ perfusion. It was also used clinically in volunteers. No acute toxicity has been reported.

This paper reviews the use of PFCE in myocardial protection due to poor perfusion. The compositions of the two commonly used perfluorocarbon emulsions (PFCE) are described. The results of some animal studies are described. The mechanisms associated with the myocardial protection with PFCE are also discussed. Primarily, it is due to the high oxygen carry capability which enhances the tissue oxygen uptake. A higher oxygen gradient is present to allow oxygen to diffuse more readily to poorly perfused regions. Its low viscosity also improves the circulation in small arteries and capillaries.

12553/06662

**Strategy For Development of Biological Engineering**

40081031 Tianjin KEXUE XUE YU KEXUE JISHU  
GUANLI [SCIENCE OF SCIENCE AND  
MANAGEMENT OF S. & T.] in Chinese  
No 9, Sep 87 pp 30-32

[Article by Zhou Chun [0719 4783], Western China Medical College: "Strategic Thinking About the Development of Biological Engineering in China"]

[Excerpts] By biological engineering is meant the application of biological science theories and certain engineering principles to the development of techniques

regarding organisms or their component parts. It includes mostly genetic engineering, cell engineering, enzyme engineering, and fermentation engineering. Biological engineering is yet another "magical" technique that follows in the wake of electronic computer techniques, prospects for the development of which are extremely astounding.

**Strategic Significance of the Development of Biological Engineering**

Biological engineering may demolish the traditional demarcation lines between species, families, or even kingdoms, and transform in predetermined ways or bring into being new biological varieties. It will be able to produce diverse pure and inexpensive valuable biological products and medicines. Its development will allow entry into a magnificent age in which mankind can create new biological varieties that meet his needs.

Applications of biological engineering are extremely broad. It can pretty well solve numerous major problems that the modern world faces in medicine, food, farming and animal husbandry, the chemical industry, energy, environmental protection, and mining. It will provide mankind with new pharmaceuticals, new therapeutic methods, new energy sources, fine animal and plant breeds, and different kinds of bacteria. It will make it possible to transform large areas of alkaline and saline land and deserts into forests and verdant farmland. Fermentation engineering will take the place of a large number of chemical plants, and will mean large scale savings of energy and very great reduction in environmental pollution. It may be foreseen that the development of biological engineering will lead to changes in the make-up of industry, the mix of products, and the economic structure, and will bring about a major take-off in social productivity. In this sense, biological engineering will become an important mainstay of the new technological revolution that is taking place in the world.

In short, the outlook for biological engineering is extremely broad, and every country has devoted serious attention to it.

**Strategic Thinking About Development of Biological Engineering in China**

For historical reasons, research on biological engineering got off to a late start in China. Thanks to efforts made during the past several years, however, quite a bit of work has been done in the culturing of plant tissues and cells, in fermentation engineering, in enzyme engineering, and in embryo transplants. A definite foundation now exists, and certain achievements have been scored; nevertheless, China is still backward in comparison with advanced world levels. Research on genetic engineering and cell fusion began in China at the end of the 1970's, and on a very small scale. In an overall sense, the gap between China and developed countries is still large. In view of China's circumstances, and on the basis of the



lessons of experiences in other countries, the following strategic thinking about the development of biological engineering are provided for discussion to enable China to catch up with the pace of development of biological engineering in the world by the end of the present century or the beginning of the next one.

1. Establishment of leadership organizations to strengthen scientific management. Biological engineering techniques are complex, relate to numerous disciplines, and pose many problems. A top level leadership organization at the ministry level should be established, and a beginning made to do the following:

a. Organize a fact-finding body made up of experts to travel abroad to make on-the-spot surveys, understand developments, collect data, introduce techniques, and develop cooperation. Only by understanding ourselves and understanding others will it be possible to attain and surpass goals.

b. Leadership organizations should organize experts and cadres on the basis of the pertinent lessons of experience of foreign countries, and in combination with realities as they exist in China, to formulate biological engineering development plans and implement policies in China, including the main direction of attack, training of skilled personnel, deployment of technical forces, the proportion of investment to be made, and liaison and cooperation with foreign bodies.

c. Establishment of a cooperative network that includes research and production to link scientific research and production so that research achievements will be promptly translated into useful industrial technology and products, thereby infusing biological engineering with greater vitality and increasing economic benefits.

2. Determination of the main direction of attack. In view of China's circumstances, research and development should be done successively in the fields of enzyme engineering, fermentation engineering, tissue culturing, cell culturing, and embryo transplants. At the same time, the main direction of attack should be on genetic engineering, and cell fusion. Since these two techniques are on the leading edge of technology, they are very difficult. Since research in these fields got off to a late start in China, since skilled personnel are lacking, and since the foundation is poor and the scale is small, priority consideration should be given to human, material, and financial resources.

3. Training of skilled personnel and laying a good foundation. In view of China's specific circumstances, a prominent task is training skilled personnel and laying a good foundation. Work in this regard may be divided into the near term, the intermediate term, and the long term.

#### Near Term Work:

1. Establishment of biological engineering intelligence and consulting organizations for the wideranging collection and translation of intelligence data, founding of publications dedicated to biological engineering for reporting the newest foreign achievements and develop-

ment trends, and to provide reading material of interest to leaders, scientific personnel, and both professors and students at institutions of higher education.

2. Strengthening of international cooperation and exchange. A number of Chinese experts may be organized for cooperation with foreign experts, and students or graduate students may be sent abroad for study. Conditions (including assistants, funds, equipment, and laboratories) should be provided to personnel returning to China to help them do their work and play a role. All of this work amounts to a short cut for training skilled personnel, for laying a good foundation, for introducing technology, and for building a teaching corps.

3. Use of multiple avenues and multiple channels for training personnel. Incumbent researcher personnel may be organized in groups and over a period of time for further study in order to consolidate the foundation and update information. Some biology professors, researchers, college students, graduate students, and doctoral candidates may be mobilized for transfer to biological engineering work. Various kinds of short term training classes, lectures, and refresher courses may be conducted to train personnel at the elementary, intermediate, and advanced levels.

#### Intermediate Term Work:

All universities, medical and agricultural schools, teacher colleges, and scientific research units concerned that have requisite conditions should actively establish biological engineering research organizations, biological engineering departments or specialties in which they should enroll the proper number of undergraduates, graduates, doctoral students, professional trainees, and administration students. Colleges should establish a biological engineering faculty and a scientific research corps that are responsible for both teaching and scientific research as a means of improving teaching quality and advancing development of biological engineering. Self-reliance and depending on resources available within China is the fundamental strategy for training personnel and laying a good foundation.

#### Long Term Work:

1. The training of a large number of skilled personnel in China and cooperation in international exchanges should form the foundation for training 500 experts per year for the next 20 years. Thus, by the beginning of the next century, China will have nearly 10,000 biological engineering personnel at the primary, intermediate, and advanced levels, sufficient to form a specialized researcher corps staffed with experts having the proper mix of ages and knowledge in the laying of a foundation for technical forces able to catch up with advanced world levels during the 21st century.

2. Biological engineering should also be given attention from infancy. Primary schools and middle schools should also organize interesting talks about biological engineering to publicize the strategic significance of the development of biological engineering and to foster interest in it from childhood. It is to be hoped that more people will undertake biological engineering research, thereby solidifying biological engineering in China, and that other people will continue to take it up so there will be hope for catching up and surpassing advanced world levels.

4. Vigorous spread of mature technology to transform traditional industry, farming, and animal husbandry. A certain foundation already exists in China for fermentation engineering, enzyme engineering, plant tissue and cell culturing, and animal fetus transplants and, in some cases, nascent industries have already taken shape. Vigorous efforts will have to be made to spread advances in order to transform traditional industry, farming, and animal husbandry. In this way, both the quantity and quality of industry and agriculture can be greatly increased, economic benefits can be greatly raised, and funds can be accumulated for further development of biological engineering.

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#### Injection Polyurethane Sperm Duct Block Developed

40081029d Beijing *PEOPLE'S DAILY [OVERSEAS EDITION]* in Chinese 1 Nov 87 p 4

[Article by XINHUASHE Correspondent Yi Fenghua [1355 1144 5478]: "China Pioneers Successful Ideal Birth Control Method For Males. Evaluated by United Nations Experts, and To Be Promoted Both Inside and Outside China"]

[Text] Medical Doctor Zhao Shengcai [6392 3932 2088], director of the Shanxi Provincial People's Hospital has successfully developed a reversible injection method for blocking the vas deferens in males. Experts from the World Health Organization of the United Nations recently evaluated this method, acknowledging it to be a

research accomplishment that makes an important contribution to mankind's birth control. This is a pioneering achievement, both in China and abroad.

Since he began this research project in 1972, Zhao Shengcai has scored satisfying results from the injection of blocks into the vas deferens of more than 10,000 males.

These blocks are polyether type polyurethane elastomers that maintain a liquid state at room temperature, but that turn into light yellow, glossy, shuttle-shape solids when injected into the vas deferens. This is an effective birth control method with a success rate of 99 percent, and it is currently the most ideal male birth control method available.

A responsible official in Neihuang County in Henan Province has reported that Neihuang County stations for publicizing planned birth control techniques have clinically tested and verified this method with 1,000 patients, obtaining good results.

Experts from the World Health Organization of the United Nations have conducted a pathological examination of the block, and have certified that the block performs consistently, is safe, and produces no side effects in the human body.

A national patent has been requested for this achievement, and Chinese health agencies will promote this important scientific research accomplishment inside and outside China.

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**New Myecin Cream To Heal Chilblain, Frostbite**  
40081036b Beijing *YAOXUE TONGBAO [CHINESE PHARMACEUTICAL BULLETIN]* in Chinese  
Vol 22 No 9, Sep 87 p 5674

[Article Collated by Zhou Lian [0719 0448 1344] and Tian Yaling [3944 0068 3781], Military Medical Research Institute, Shenyang Military Region: "New Myecin Cream To Heal Chilblain and Frostbite"]

[Text] Chilblain is a non-freeze injury caused by cold and wetness. This is an illness frequently seen in late fall, winter, and the early spring seasons. Frostbite occurs at low temperatures below the freezing point, and is a common illness in north China during the severe winter season.

China has numerous methods for healing chilblain and frostbite, but few of them yield ideal results. In the study of highly effective and quick acting healing medicines for chilblain and frostbite, we performed animal experiments to develop a new sulfuric acid myecin cream. From December 1984 through March 1986, we used a 2 percent new myecin cream (termed "851" for short) to heal 371 cases of chilblain, 266 cases of light frostbite



(first and second degree), and 15 cases of severe frostbite in Xian, Shenyang, the Heihe Region, Qiqihar, and the Gedaqi Region. We used a 1 percent furacillin cream (termed "741" for short) as a control. Results showed effectiveness of treatment with the 851 to be markedly superior to those from the 741. A report is provided below.

### 1. Treatment Method

Where there were no open sores, a 75 percent solution of alcohol on cotton balls was used as an antiseptic. When sores were blistered, ulcerated, or eroded, the surface of the sores was repeatedly bathed lightly with a saline solution after which the 851 was applied and the sores were wrapped in sterile gauze. The medication was changed once each day. The control preparation was 741, which is generally recognized in China as an effective remedy for healing chilblain and frostbite, that contains 1 percent furacillin.

### 2. Treatment Results

#### a. Chilblain Treatment Results

The 851 was used to treat 371 chilblain cases. It was effective in 94.6 percent of them, and produced healing in 67.4 percent. The 741 was used to treat 153 cases. It was effective in 83.0 percent of them and produced healing in 44.4 percent. Comparison of the two showed

an extraordinarily marked difference in their effectiveness rates and healing rates. Average number of days for healing: For the 250 cases that 851 healed, the average number of days required was 3.89. For the 68 cases that 741 healed, the average number of days required was 4.15. The healing rate within 3 days was 52.8 percent for the 851. For the 741, it was 38.2 percent,  $P < 0.05$ , a marked difference between the two. For times when major symptoms disappeared, please see Table 1.

**Table 1. Time (Days) When Major Symptoms Disappeared in the Healing of Chilblain With Two Creams**

Pharmaceutical	Swelling	Hard Crust	Ulceration	Erosion
851	3.09	2.89	2.04	2.37
741	6.22	3.74	2.67	3.92

#### b. Results From the Healing of First and Second Degree Frostbite

It took an average of 2.69 days for the 851 to heal first degree frostbite, and 3.56 days for second degree frostbite. The 741 took an average of 3.74 days to heal first degree frostbite, and 5.25 days to heal second degree frostbite. The heal rate within three days was 79.6 percent for first degree frostbite, and 61.5 percent for second degree frostbite using the 851. For the 741, the 3 day heal rate for first degree frostbite was 58.4 percent, and 23.1 percent for second degree frostbite. For times when symptoms disappeared, please see Table 2.

**Table 2. Average Time (Days) of Disappearance of Major Symptoms For First and Second Degree Frostbite**

Pharmaceutical	Swelling		Soreness		Itching		Blisters	
	First Degree	Second Degree	First Degree	Second Degree	First Degree	Second Degree	First Degree	Second Degree
851	1.54	2.05	1.35	1.59	1.89	2.06		1.47
741	2.34	2.86	2.00	1.92	2.96	3.31		2.30

c. Serious Frostbite (third and fourth degree frostbite). The 851 alone was used externally to heal 12 cases of serious frostbite (including nine cases of third degree frostbite, and three cases of fourth degree frostbite. Except for one case of fourth degree frostbite who entered the hospital 10 days after freezing to have the great toe on his left foot removed to the first joint, and one case in which necrosis of the first and second joints of the third finger developed, no impairment took place in the other 10 cases. The 851 was used externally, and low molecular dextran was dripped into a vein to heal three cases of third degree frostbite, which healed completely with no impairment.

### 3. Discussion

In determining the advantages from external treatment of chilblain and effectiveness in treatment of frostbite,

the most important data were the average average number of days for healing, and consideration of the time required for principal symptoms to disappear. Results of our observations show that the average number of days for healing and disappearance of major symptoms when the 851 (new myecin cream) was used to heal chilblain and first and second degree frostbite were markedly fewer than for the 741 (furacillin), and there were no problems of oversensitivity or adverse reactions. Not only did the 851 do an outstanding job of healing chilblains and frostbite, but it also was very effective against serious frostbite. It is currently a rather satisfactory externally used healing cream.

### Planning For Environmental Protection in Seventh 5-Year-Plan

40081001a Beijing ZHONGGUO HUANJING KEXUE  
[CHINA ENVIRONMENTAL SCIENCE] in Chinese  
Vol 7 No 3 Jun 87 pp 59-63

Article by Zang Yuxiang [5258 3768 4382], Science and Technology Department, State Environmental Protection Bureau, Beijing: "Cursory Comments About Planning of Environmental Protection in the Seventh 5-Year Plan Period"]

[Text] Highlights. This article capsulizes scientific and technical research plans for national environmental protection during the Seventh 5-Year Plan, as well as the principles to be used in defining tasks, the kinds of research to be conducted, and the basic research goals to be achieved.

The Seventh 5-Year Plan Period is a key period for carrying out complete reform of the economic system and for realizing a quadrupling of gross industrial and agricultural output by 2000. It is also an important period for all-around strengthening of environmental control and building the environment, for making scientific and technological preparations, and for setting the stage to bring about a fundamental change for the better in the state of the country's environment by the end of the present century. Therefore, conscientious performance of scientific and technical work in environmental protection during the Seventh 5-Year Plan holds important significance for the realization of the country's strategic goals for environmental protection and for promoting the building of socialist modernization.

The main requirement for rendering a good performance in scientific and technical work for environmental protection during the Seventh 5-Year Plan is good scientific and technical planning. As long ago as 1983, the State Planning Commission, the State Economic Commission, and the State Science and Technology Commission took the initiative in organizing environmental protection specialists to plan scientific and technical work for environmental protection during the Seventh 5-Year Plan Period. As a result, plans were formulated for study of techniques for the prevention and control of pollution from the burning of coal; for urban treatment systems for polluted water and soil, and for turning polluted water into a useful resource. Study of environmental capacity and environmental background values for some places in the country has become a major scientific and technical problem to be tackled during the Seventh 5-Year Plan period. Since 1985, the State Environmental Protection Bureau has also used the scientific and technical problems to be tackled in the country's environmental protection during the Seventh 5-Year Plan as a basis for further increasing the number of environmental specialists and for improving their quality. This has been discussed and approved by the scientific and technical

work conference of the national environmental protection system, and a scientific and technical plan has been formulated for national environmental protection during the Seventh 5-Year Plan.

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan proceeds from the country's realities. Analysis of the state of the country's environment and its economy has suggested some urgently needed research for the country's environmental protection work. Study and solution of these problems is bound to play a tremendous role in giving impetus to the country's environmental protection work.

#### 1. Intensified Research on Environmental Control, Efforts Being Made to Provide Data To Make Environmental Control More Scientific

Environmental control in China is fairly weak at the present time. Statistics show between 30 and 50 percent, and in some places between 70 and 80 percent, of industrial pollution in China as resulting from poor control. For this reason, one important task in environmental protection in the country at the present time is the strengthening of environmental control. Vice-Premier Li Peng said explicitly at the Sixth Session of the State Council Environmental Protection Commission: "On what do we depend for the prevention and control of pollution? On policies, on controls, and on technology." This fully shows that the strengthening of environmental control is not just a current need in environmental protection work, but is also an important indicator that a Chinese road is being taken in environmental protection. Strengthening of environmental control entails not just continued intensification of the building of environmental protection organizations and improvement in the quality of environmental protection personnel; another important task is to make environmental controls scientific. Analysis of the present state of the country's environmental controls was done in the preparation of scientific and technical plans for environmental protection during the Seventh 5-Year Plan, and environmental control systems, plans, laws, standards and topics for study that included some environmental protection policies were proposed.

#### (1) Study of the Environmental Control System

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan sets forth topics for study pertaining to the environmental control system. Unless our environmental control system is healthy and strong, it will be very difficult to carry out a series of plans, policies, rules and regulations and standards for environmental protection.

Environmental work has a bearing on all sectors, all areas, and all industries; it applies very much to society as a whole and cuts across all walks of life. Without a powerful coordinating and supervisory organization at a high level, and without a scientific division of labor and

cooperation in all control organizations, a good job of environmental control is impossible. There is a general lack of coherence at all levels among environmental control organizations in the country today, and the division of labor among organizations has not been well defined. This is bad for environmental control. The environmental control system should be in tune with the country's economic system. During the Seventh 5-Year Plan, studies of the environmental control system will serve the purpose of providing scientific data for the building of an environmental control system that is in keeping with the country's present economic system.

## (2) Study of Environmental Planning

Definition of pollution control objectives and objectives for controlling damage to the ecology, and then exercising controls in accordance with these objectives has been the road taken by all the countries of the world in environmental control, and it is also an important control technique that is being applied in China today. However, inasmuch as the country's environmental protection work has not really been made a part of state economic plans for the past 10-odd years, the proportion of funds to be spent on environmental protection has not been defined in state economic plans. Of the several channels for environmental protection funds that have been defined, the percentage under control of environmental protection agencies is very limited. Therefore, even though management by objective has been instituted, in reality, the set objectives frequently have not been attainable. Furthermore, study of environmental protection goals has long been insufficient; frequently goals have been set too high, and difficulties in realizing objectives have not been adequately assessed.

The scientific and technical plan for environmental protection during the Seventh Five Year Plan uses Sixth 5-Year Plan period environmental forecasts in order to meet needs for environmental control, and emphasizes China's development over the intermediate and long term, i.e., in 2000, 2020, and 2050 in formulating environmental protection plan objectives. It also included study of the corresponding percentages of environmental protection funds needed in state economic development plans for the achievement of these goals. In studying environmental plans, representative areas of the country were also selected where studies could be made of regional environmental planning methods and steps to be taken for the purpose of providing needed methods and techniques for the country's future implementation of environmental plans, and to provide data for the formulation of environmental plan norms.

(3) Study of Environmental Laws. Legal control is the most compelling kind of control. During the past 10 years and more, China has devoted extremely serious attention to legal control of environmental pollution. The country's constitution explicitly provides for "national environmental protection and improvement of the living environment and the ecological environment, and

the prevention and control of pollution and the social effects of pollution." In addition, "The Environmental Protection Law of the People's Republic of China" has also been promulgated together with a series of separate laws pertaining to protection of the environment, and environmental laws for some areas. These laws have played an important role in improving the ecological environment, in preventing and controlling pollution, and in heightening people's environmental consciousness.

China's environmental laws are still not on a completely sound footing today; sometimes legal responsibility is not explicitly assigned; and there are no specific policies pertaining to awards and preferential treatment. In particular, the scientificness and feasibility of current environmental standards that serve as a basis for law enforcement are poor. Consequently, the power of environmental laws cannot be brought to bear.

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan makes use of the country's environmental legal system for steady improvement and strengthening of the country's environmental laws, and to provide scientific data for the phased building of an environmental control system guaranteed by law. Study of environmental laws requires not only study of environmental legislation, but also penetrating study of the country's administration of justice in environmental cases.

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan includes study of the country's environmental standards by way of achieving strict enforcement of environmental protection laws. As a result of this study, pollutant emission standards based on regulation of total volume are to be phased in to replace the present system of pollutant emission standards based on density. Institution of a system of standards based on control of total volume will not only better insure improvement of environmental quality, but should also promote a rational pattern of distribution of industry, spur steady progress in production technology, and make this system of standards more advanced and more rational. In studying this system of standards, not only is it necessary to take into consideration the special environmental characteristics and functional requirements of regions, but also to do a good job of analyzing the economics of technology, the better to formulate pollutant discharge standards that are more in keeping with the country's circumstances. The scientific and technical plan for environmental protection during the Seventh 5-Year Plan emphasizes study of local discharge standards. Zoning of functional areas, the setting of standards for environmental quality, calculation of the environment's capacity for pollutants, and determination of the total amount of pollutants discharged are used in conjunction with an analysis of the region's economics of technology to set apportionment rates for all sources of pollution.

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan not only calls for a system of standards for the water environment and the atmospheric environment, but also calls for the study of quality standards for the soil environment, standards for the discharge of solid wastes, and standards for offensive odors, thereby enriching and perfecting the country's existing environmental standards.

#### (4) Study of Environmental Policies

Environmental policies serve to guide the exercise of environmental controls, and play a decisive role in coordinating the building of the economy and in building the environment. Therefore, intensified study of certain environmental policies, analysis of results obtained from the implementation of these environmental policies, and heightened consciousness about implementation of these policies are extremely important in the further strengthening of environmental control.

During the past 10-odd years, China has formulated a series of environmental protection plans and policies such as the "Three In Steps," the "Three Benefits," and the "Complete Control Through Precautions First, Linked to Prevention and Control." All of these policies have been rooted in China's national circumstances and have been distilled from practice; however, today there is a certain shortfall in the implementation of these policies. Take the policy of "Complete Control Through Precautions First, Linked to Prevention and Control," for example. Despite our formulation of a series of concrete actions to be taken for the implementation of this policy, such as the preparation of environmental impact assessments and the taking of three simultaneous actions at the outset of new projects; the technical transformation of old enterprises as well as the closing, suspension, merger or relocation of them; the fining of enterprises that discharge excessive amounts of pollutants, etc., the focus of these measures has been primarily on individual sources of pollution rather than on a wider area. Specific technical policy actions are missing; consequently environmental results have not been notable. For this reason, in the study of environmental protection policies, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan emphasizes comprehensive prevention and control policies for area-wide environmental pollution, using the study of techniques for comprehensive prevention and control of area-wide environmental pollution during the Sixth 5-Year Plan period as a basis for highlighting the study of policies. This should give powerful impetus to comprehensive prevention and control of area-wide pollution in China.

#### 2. Study of Techniques For Strengthening Environmental Pollution Control, and Efforts to Provide A Store of Technical Data For Environmental Control During the 1990's

Though reliance on environmental control to solve environmental problems is an effective measure of strategic significance in today's environmental protection endeavors, there is a limit to the environmental problems that environmental controls can solve, and ultimately reliance must be placed on engineering projects to improve the quality of the environment.

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan focuses on the current state of China's environmental pollution, and takes firm grip on the problem of harnessing pollutants that cover large areas, such as the problem of harnessing the dust and sulfur dioxide that creates atmospheric pollution; the problem of controlling organic compounds in urban sewage that pollute bodies of water; the processing and disposal of toxic and harmful industrial effluent in solid wastes, etc. It calls for widespread study of practical techniques that cost little money and produce quick results.

#### (1) Study of Techniques For Handling Water Pollution

Pollution of the water environment is a conspicuous problem in China's environmental pollution. Results of an early 1980's survey of 878 rivers shows that 5,322 kms of a total of 92,806 kms of waterways contain foul smelling water in which fish and crustaceans have become extinct. Seventeen of the country's major rivers have been polluted. In particular, sections of rivers that flow through cities are universally polluted.

Pollution of the country's water environment has resulted primarily from the year by year increase in urban pollution, and the discharge of pollutants at will in the absence of effective control measures. Today, China's cities produce 18 billion tons of sewage annually (according to statistics from 75 cities), only between 2 and 3 percent of which is treated. In light of the country's economic circumstances at the present time, the investment of large sums in two stage sewage treatment plants is impossible in the near term. Therefore following an analysis of the state of the country's water environment and of the state of the economy, and on the basis of a study of the environment's capacity during the Sixth 5-Year Plan period, the scientific and technical plan for environmental protection during the Seventh Five Year Plan calls for the study of a combination of artificial treatment and natural purification for the treatment of urban sewage in multiple ways, principally through natural purification. Bearing in mind the country's natural conditions, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan calls for study of a system that emphasizes development in arid areas of north China of the processing of urban sewage for use on the land, thereby organically linking the processing of urban sewage and the turning of sewage into a resource. In south China areas that are near large bodies of water, and in cities along the seacoast, it calls for study of techniques for the discharge into rivers and into the sea of urban sewage after one stage processing,



making full use of the self-purification capabilities of large bodies of water. Where conditions permit in medium and small urban areas, techniques for using oxygenation ponds to process urban sewage should continue to be studied, every effort being made to combine processing with use, rather than just processing, so as to derive greater economic benefits and environmental benefits. In cities where environmental quality requirements are high, further study should be given new technology for two stage, high efficiency processing of sewage using low consumption of energy. These ideas fit in fairly well with China's national circumstances. Many cities in north China are located in water short areas, while quite a few cities are close to large rivers and the open sea with a substantial water environment capacity. If these techniques prove successful, they will give extremely great impetus to urban sewage control in China and will yield marked environmental and economic benefits.

The study of a system for processing urban sewage for use on the land, and of techniques for discharging urban sewage into rivers and the sea following simple processing that are called for in the scientific and technical plan for environmental protection during the Seventh 5-Year Plan, differ from traditional land irrigation and the discharge of sewage into rivers and the sea of the past both conceptually and in terms of technical requirements. In traditional irrigation, no consideration was given to the processing of urban sewage, but rather urban sewage was used primarily for its value as a liquid fertilizer. Past discharge of urban sewage into rivers and the ocean simply used rivers and the ocean as cesspools, no consideration being given to issues such as the protection of bodies of water or the ability of bodies of water to purify urban sewage. Therefore, study of a system for processing sewage for use on the land not only provides an economically beneficial technique for handling urban sewage, but also offers a solution to the problem of polluting the land and bodies of water that is created by lack of scientific management of irrigation and the senseless release of sewage into the rivers and the ocean.

In the implementation of measures such as the system for treating sewage for use on the land, the discharge of sewage into rivers or the sea following simple processing, or the processing of sewage in oxygenation ponds that are called for in the study of techniques for processing urban sewage, rigorous control must be exercised over industrial wastes containing heavy metals, and not readily biodegradable toxic and harmful organic substances.

For sources of pollution for which no fairly good processing techniques have been found, such as the effluent from paper manufacture, waste water from printing and dyeing plants, and waste water containing heavy metals from the electroplating industry, scientific and technical planning for environmental protection during the Seventh 5-Year Plan also emphasizes further study.

## (2) Study of Techniques For Controlling Atmospheric Pollution

Atmospheric pollution is fairly serious in China. In some cities, particulate matter suspended in the atmosphere reaches nearly 100  $\mu$ g per cubic meter, several times again as high as the amount in the city reported by the World Health Organization as having the most serious atmospheric pollution, Calcutta. The sulfur dioxide content of the atmosphere in some of China's cities is also seriously in excess of standards, with some cities suffering damage from acid rain. The main reasons for the fairly serious atmospheric pollution of China's cities is the burning of coal as a primary source of energy. For this reason, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan focuses particular attention on the country's atmospheric pollution and emphasizes the study of techniques for harnessing pollution from the burning of coal, including study of the development of types of coal for use in industry and in daily life, high efficiency dust elimination techniques, techniques that use new type boiling furnaces to fix the sulfur in coal, and techniques for the elimination of smoke and the removal of sulfur by thermal power plants, thereby providing a series of important practical techniques for solving pollution resulting from the country's burning of coal, for effective improvement of the environmental quality of the country's atmosphere. In addition plans have been laid to study the factors that contribute to acid rain in the country, its spread, and the damage it causes.

In recent years, a dramatic increase has taken place in the number of motor vehicles in some of the country's cities. This has caused motor vehicle exhaust gas pollution. Consequently, study of techniques for controlling motor vehicle exhaust gas pollution has also been made a part of the scientific and technical plan for environmental protection during the Seventh 5-Year Plan.

## (3) Study of Solid Waste Processing Techniques

Pollution caused by solid waste has not previously been sufficiently understood nor has sufficiently serious attention been given to it. Several incidents involving pollution have demonstrated that without proper control and processing of solid wastes (particularly harmful and toxic wastes), they will seriously pollute the environment, and some of the pollution of the soil and bodies of water, in particular, will be irreversible. Therefore, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan stresses study of methods for the processing and disposal of harmful and toxic industrial waste in order to provide data for the building in China of centralized processing facilities for toxic and harmful wastes.

## (4) Study of Noise Control Techniques

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan lists noise pollution as an important issue in the urban environment. During the Seventh 5-Year Plan period, stress is to be given the study of urban traffic noise control.



### (5) Study of How to Prevent and Control Pollution From Township and Town Enterprises

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan emphasizes study of not only techniques for controlling water pollution, atmospheric pollution, the processing and disposal of solid wastes, and noise control, but also lists topics for study relating to the increasing problem of environmental pollution caused by township and town enterprises. Available statistics show 12 million township and town enterprises in the country with a gross output value that surpasses the output value of agricultural production, and that is increasing at an annual 14.5 percent annually. Development of town and township enterprises plays a very important role in invigorating the rural economy, but the environmental pollution that it causes is also rather serious. Generally speaking, town and township enterprises are widely scattered, have antiquated technology, use resources inefficiently, consume large amounts of energy, and cause great pollution. They also lack the funds to control pollution, and quite a few enterprises onesidedly pursue economic results, no thought whatsoever being given to environmental results. Therefore, unless the problem of pollution by town and township enterprises is solved, environmental pollution will be shifted from the cities to the rural villages, its sources spreading from points to wide areas resulting in even greater damage to the country's environmental ecology. For this reason, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan will study environmental pollution by town and township enterprises from the standpoint of policies, planning, and control techniques.

### 3. Increased Study of the Effects on Human Health of Natural Protection and Environmental Pollution In an Active Effort To Provide Data for Policies

Ours is a vast land with a large population, the amount of resources per capita not being plentiful by any means. The amount of biological resources per capita, in particular, is very small, resulting in great pressure on the environment. How to maintain a fundamental balance in the ecological environment is an issue that merits study. In this regard, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan calls mostly for study of effective protection and equitable development of resources for use in already established natural protection areas, study of protection policies and laws to protect endangered plant species, as well as study of a benign cycle in the country's agroecology. Study of a benign cycle in the agroecology has begun only during the past several years. During the Seventh 5 Year Plan, existing ecological pilot projects will be used as a basis for development in the direction of better norms and greater quantification, study thereby becoming more thoroughgoing.

One of the fundamental objectives in protecting the environment is the protection of human health. Heretofore, there has been insufficient study of the effects on

human health of environmental pollution; therefore, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan emphasizes study of the effects on human health of heavy metals pollution, environmental pollution caused by the burning of coal, and motor vehicle exhaust gas pollution for the purpose of providing data for policies.

### 4. Serious Attention to Turnovers of Scientific and Technical Achievements in Environmental Protection in an Effort to Increase economic and Environmental Benefits From Scientific Research

Formerly scientific and technical planning for environmental protection devoted attention only to research projects handed down from above, caring little about whether scientific and technical achievements could be translated into productivity. This resulted from longstanding shortcomings in the scientific and technical system itself, which divorced scientific research from production. The scientific and technical plan for environmental protection during the Seventh 5-Year Plan calls for the study of turnovers of scientific and technical achievements in environmental protection in order to translate these achievements into productivity as soon as possible. The scientific and technical plan for environmental protection examines production practices to identify scientific research achievements that may feasibly be collected, collated, evaluated and given further promotion, the better to serve production and control. At the same time, other scientific research achievements are also to be categorized, collated, evaluated, and compiled in a planned way to produce coherent data. The collection and spread of these scientific research achievements not only makes them accessible for production and control, but also points the direction for deeper research. It also helps overcome the widespread low level duplication of research that now occurs because information is not disseminated.

The problems and goals that the scientific and technical plan for environmental protection during the Seventh 5-Year Plan focuses on are major environmental problems that are currently in urgent need of solution in China. Since these problems touch on many different academic fields, some will require multi-discipline cross-fertilization and joint efforts by different sectors, which means a certain amount of complexity. Consequently, fulfillment of the scientific and technical plan for environmental protection during the Seventh 5-Year Plan is a rather daunting task. We must strive to do a good job of reforming the scientific and technical system, of strengthening scientific and technical control of environmental protection, and of concentrating forces to insure complete fulfillment of the scientific and technical plan for environmental protection during the Seventh 5-Year Plan.

### **General Strategy For Satellite, Optical Fiber Communications Outlined**

40080036 Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese Sep 87 pp 1-10

[Article by Kan Kaili [7074 0418 0500]: "A Probe Into the Comprehensive Development of Satellite and Optical Fiber Communications in China"]

[Excerpts] Optical fiber and satellite communications represent two extremes of the transmission technology spectrum. Thus, in China, where the current volume of long-distance traffic is low but steadily increasing, the best strategy is to use the two to complement, not to compete with, each other. That is, first use satellites to meet the immediate demand, and then make a transition to an optical fiber or other large volume terrestrial system when the traffic reaches a certain level. This will not only eliminate waste of capacity and capital, but also will bring important benefits to the whole network.

#### **Presentation of the Problem**

Satellite communication and optical fiber communication are two major technological breakthroughs in communication transmission in the past 20 years. Satellite communication began to be developed in the 1960's and has been widely used in long distance communications since the 1970's. In the 1980's, because of continuously improving performance and decreasing cost, many arguments exist abroad that optical fiber communication and satellite communication are competing with each other [1] [2]. Some researchers studying communication technology strategy indicate that optical fiber will replace the satellite in all point to point communications [3]. This may be true for Western countries where the volume is very high because the demand for high capacity channels exists. In China, as the communications industry grows, there is no doubt that optical fiber is the direction to take in long distance communications. However, the timing will have to be carefully considered based on the present situation in China.

Long distance communications can be characterized by the following features: low volume (in comparison to developed nations), steady high rate increase (more than 10 percent per year on the average), and no possibility of "explosive" growth due to limited increase in urban networks. These features are consistent with the situation in most developing countries [4].

In view of the increasing demand in long distance business, it is obviously impossible not to rapidly construct more long distance communications networks. This is because the supply and demand situation will deteriorate to such a level that urban telephone networks may even be affected [5, 6, 7].

However, not only is it difficult to meet the demand in time by installing optical fiber systems on the long distance trunk lines, but also most of the capacity will remain idle for some time, resulting in the waste of a large amount of capital. On the other hand, if China does not make a transition to optical fiber communications, it will not meet the demand of large scale growth in communications. Hence, when formulating the communications technology policy for China, the advantages and disadvantages of various transmission means, especially those associated with satellite and optical fiber communications, must be compared for better utilization of the technology.

#### **Strategy for the Comprehensive Development of Satellite and Optical Fiber Communications**

In addition to better interference resistance and high security, the biggest advantage of an optical fiber system is high capacity. However, its overall construction cost is high and is proportional to distance. Furthermore, it takes a long time for a large project to go through the design, construction and operation cycle. Satellite communication has the opposite characteristics. Its cost is related to volume, but independent of distance. It takes less time to be in operation. Therefore, it is more economical to use both satellite communication and optical fiber communication in the long distance network than to use a single system during the period of growth.

Specifically, the strategy consists of three steps:

- (1) Use satellite when a system is initially built or expanded because the demand is usually low.
- (2) Increase satellite capacity gradually as the demand increases.
- (3) Finally, make a transition to optical fiber or other terrestrial systems when the capacity reaches a certain level.

Compared to immediate installation of optical systems, the first advantage of this strategy is that the vast capital required for the construction of such systems is delayed. This avoids capacity waste in the early stage and capital lying idle. Consequently, the economic benefits are tremendous.

It can avoid the situation where several large scale optical fiber projects are being constructed simultaneously to allow us to concentrate our limited manpower and resources. In addition, we may be able to develop our own optical fiber design and construction team as we proceed with these projects one at a time.

An optical fiber or other large volume terrestrial communication system (such as co-axial cable) usually takes several years to construct. A satellite channel, however, can be finished in a few months or a year regardless of

distance. It takes even less time to expand the capacity of an existing ground satellite station. Therefore, it not only can satisfy the demand and growth of long distance business immediately, but also can be quickly put in operation to speed up the cash flow.

In this strategy, using satellites in the early stage can avoid any relay transmission to achieve point to point communication in China. In addition, because capacity can be gradually expanded based on demand, no "bottleneck" will develop in the entire system. Furthermore, the business will become more reasonable to handle. This will create the condition for a balanced growth in the future.

The beams from a communications satellite cover the entire country. Its transmitter can be shared by many point to point channels. Hence, even if we do not employ a demand assigned multiple access (DAMA) system, the circuits can be periodically adjusted according to the business demand. Thus, the utilization rate of the capacity of a satellite system is high. The flexibility of this type of system cannot be matched by any terrestrial system.

The demand in data communication in China is rising rapidly. However, due to insufficient line distance lines and poor transmission quality, this business has not grown in recent years. Satellite circuits can directly provide high quality digital channels. It is an ideal means for us to make a transition to optical fiber communication or digital microwave communication.

Satellite communication has been developed for approximately 20 years. The technology has matured and the cost is relatively stable. In comparison, optical fiber technology is still being rapidly developed. The cost is still steadily dropping. China already has some capability to produce microwave equipment. It would be easier to develop the capability to manufacture equipment used in satellite ground stations. China's ability to manufacture equipment for optical fiber systems is comparatively lower. Therefore, by using satellite communications in quantity in the initial stage and installing optical fiber systems for short distance and high volume transmissions not only will we save a great deal of hard currency but also gain some time to allow us to catch up in optical fiber technology. This prevents us from prematurely rushing into a technology on a large scale and facing the consequence of obsolescence in a few years.

### Conclusions

This paper attempts to introduce a suitable strategy for China by developing both satellite and optical fiber communications. Thus, in China, where the current long distance volume is low, we first construct satellite communications or expand the capacity of existing systems. As the business grows, the capacity will be gradually increased. Finally, as the volume reaches a certain level, we will then make the transition to a high capacity optical fiber or other terrestrial system. In this strategy,

satellites are not only suited to establishing communication in remote areas but also more suited for rapidly expanding the long distance network in China. By doing so, it is less capital intensive and more effective. In addition, it will stimulate China's electronic industry to grow and save a large sum of hard currency. This will create the condition necessary to adjust the telecommunication network structure for a balanced development in the future.

In order to adopt this strategy, we not only must do a better job in business volume projection and conduct a comprehensive planning of the network, but also make adjustment to the economic reform in China, particularly the reform of the investment system for basic construction. In addition, we should quickly develop high capacity satellite communication circuits to take full advantage of this strategy.

The principal idea of this strategy is to combine various means of communication. Among these means, in addition to satellite and optical fiber, microwave circuit, especially the recently developed digital microwave technology, will be widely used in long distance communications in medium or short range. It is not discussed in this paper due to time limitation and lack of information. The author believes that a comprehensive long distance communication technology scheme can be quickly developed by combining the special features of various transmission means.

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#### Results of Satellite Space Experiments Said Encouraging

40081038c Beijing RENMIN RIBAO in Chinese  
13 Oct 87 p 7

[Article: "French Scientists Make Public Results of Two Experiments and Consider China's Satellite Space Experiments Encouraging"]

[Text] French scientists announced here on 9 October that the results of two experiments conducted using a Chinese earth-orbiting satellite were "encouraging".

In the middle of August this year, China launched a scientific experiment satellite into orbit using a "Changzheng 2" rocket. The satellite was recovered after five days of operation in space. The satellite carried two French scientific experiments. One experiment concerned the ability of algae to carry on synthesis and continue to grow in a weightless state. This experiment was the work of a scientific research team of the Cellular Bioengineering and the Cellular Biology Laboratory of the French National Scientific Research Center. They placed nostoc communa and euglena in a sealed container for a two-month period. During this time these algae were in a "dormant" state. Then after the Chinese satellite entered earth orbit they were in a weightless state. According to Mrs. Lefueryitelang [transliteration] who was in charge of the experiment, when the experiment began they wanted first of all to make these algae "revive", thus it was necessary to provide a light source

for them. The experiment proved that after being stimulated by a light source, the algae began to conduct photosynthesis, the nostoc communa released oxygen providing the oxygen needed by the euglena, and the latter began to provide carbon dioxide for the former. The aim of this experiment was to find an oxygen and food source biosystem for astronauts in long term orbits in the future.

The French scientists were encouraged by this experiment, but they were also a little disappointed. This is because although these algae existed well during the five weightless days, they did not reproduce, and it was discovered that only a few nostoc communa seemed to "sprout". They believe that the reproductive function of algae may have changed too slowly due to being in a weightless state. Mrs. Lefueryitelang said: "If the experiment time had been a little longer, the algae which had shown signs of reproducing might have changed our expectations."

Another experiment conducted on the Chinese satellite was carried out by specialists from the Matra Company. They wanted to measure such data as acceleration and vibration in the process from launch to recovery in order to prepare for future production of special materials and substances. It is said that the Matra Company will carry out this experiment again.

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#### Problems, Countermeasures in Coordination of S&T and Production

##### Coordination Difficulties Outlined

40080029a Beijing KEJI RIBAO in Chinese  
5 Oct 87 p 3

[Article by Yang Derun [2799 1795 3387] : "Difficulties and Countermeasures of Coordination of Science and Technology With Production"]

[Text] Currently, the problem of the dislocation of science and technology and production is still rather widespread and has become an important factor restricting economic development. Conscientiously dissecting and exploring the difficulties and countermeasures of combining China's science and technology with production, stressing "coordination point" work of science and technology with production will accelerate the pace of modernization. This is an important issue which deserves serious consideration and research.

At present, the difficulties in coordinating science and technology with production in China are primarily in three areas:

(1) Enterprises lack the inherent dynamic and strength to adopt new technology and this is an important aspect of the difficulty in coordinating science and technology with production.



Why can't enterprises actively adopt new technology? 1. Numerous production organizers and leaders have outdated ideas and have not yet understood that modern science and technology are the most dynamic and decisive production forces, and are a strong mainstay for increasing labor productivity. They are accustomed to taking the path of extensive expanded reproduction. 2. Enterprises lack the inherent dynamic to adopt new technology. In China, where supply of raw materials and prices of energy needed for production are not sensible, where there is much unemployed reserve labor, and where labor is cheap, enterprises can rely for their existence and expansion on such simple methods of expanded reproduction as increasing investment of labor and material, there is no need to exercise their brains or expend energy in adopting new technology. 3. Adopting new technology is through experiment and development, there is a certain risk, and if they succeed with a superior product of not high value, enterprise profits will be small so there is no great advantage. If they fail there is no one to compensate them for their losses and the enterprise finds this hard to accept. 4. Many plant directors and managers have the idea of "success of that year" and "success of that session" and think of ways to give bonuses, build houses, acquire things which bring quick success and instant benefit. In their term of office goal responsibility system there is a general lack of strict technical advancement norms, and funds for technical advancement are few. Technical development expenses for enterprises in the advanced countries abroad are generally over 5 percent of sales, but the technical development expenses of China's enterprises are generally 0.2-0.3 percent and many enterprises basically do not have technical development expenses. 5. Enterprise tax levies are heavy, reserve finances are few, self-development ability is weak, there is a general lack of funds for technical advancement and the strength to adopt new technology and purchase the results of science and technology is lacking. For many enterprises, after handing over the various taxes and capital, the reserved profit accounts for only 10-20 percent of the gross profits and at the same time they must also take on the heavy burden of "enterprise run societies" and lay out many types of expenses and support, so that the remaining funds are very few. 6. The technical quality of many medium and small scale enterprises, especially town and township enterprises, is poor, personnel are in short supply, and even if they can bring in advanced technology it is difficult for them to absorb and digest it, and management work cannot catch up either.

In view of this situation in enterprises, it is difficult to achieve a seller's market and competitive situation for technical results, and some results end up on the shelf. This is the dominant situation in the dislocation of science and technology with production at present.

(2) There are also many problems in science and technology departments. Science and technology departments are the developers and suppliers of results and

whether or not the research results of science and technology personnel can conform to the needs of economic and social development and find suitable markets is also the key to coordinating science and technology with production. For a long time, many science and technology personnel have been accustomed to working in splendid isolation, selecting their topics from documentary materials and undertaking projects with very little knowledge of the key problems in enterprise production technology and no familiarity with the market demand situation and since the topics selected are not appropriate, the science and technology results developed suit no one so there is no way enterprises can adopt them. A fairly large number of scientific research units lack intermediate testing or trial production conditions, the result parameters are incomplete, the technology is not mature, results are "half-baked" and enterprises do not dare adopt them. The discrepancy between the value of technological results and prices now is very severe, intellectual products are not worth any money, many science and technology results which represent advanced productive forces and excellent results in which a great deal of physical labor and material labor has been invested are transferred as quickly as possible but only the low priced ones sell and some exhibit the phenomenon of being hung upside down so that the science and technology departments cannot hope to make a profit. Many enterprises and departments in charge are not accustomed to spending money to buy technology so the problem of paying little, delaying payment, or even not paying for transfer of results frequently occurs which has an impact on the initiative of science and technology personnel to develop and transfer science and technology results and adding difficulties to the coordination of science and technology with production.

(3) The government lacks a comprehensive and compelling policy and social environment for promoting the coordination of advanced science and technology with production. Currently, the science and technology system and economic system, with the government departments formulating programs and plans from the top down, rely on each doing things its own way and forming their own system even in organizing and implementation. In science and technology programs and plans the phenomena of separate formulation and dislocation of national economic planning, technical reform planning, and technological importing planning is very severe, comprehensive balance and coordination is insufficient, and this type of dislocation of science and technology with production is a fundamental dislocation and in situations where command-type planning still plays the dominant role, it is difficult to coordinate science and technology with production comprehensively and well. At the same time, the policies formulated and issued by government departments are incomplete and imperfect and add difficulty to coordination of science and technology with production. In particular, the reform of the financial system is not in step with reform of the economic, science and technology, and educational systems, and in the areas of tax revenues and credit, specific



effective policies for supporting the coordination of science and technology with production are lacking and the relaxed social environment has not taken shape and this is a difficulty in China's current coordination of science and technology with production.

The fundamental countermeasures for resolving the difficulty of coordinating science and technology with production is in-depth reform, developing a planned commodity economy, and implementing the integration of science and technology and the economy. We currently need to begin with the following measures and resolve the problems on multiple fronts together.

First, strengthen the ability of enterprises to absorb and develop technology, guide and intensify the dynamic and energy of enterprises to adopt new technology, invigorate the sellers market for technological results, enterprise assessment norm systems should be improved, in enterprise assessment and the term of office goal responsibility system of plant heads, ratios of technological development funds to profits or sales and the value of new products to the gross value of product should be clearly stipulated, economic, legal, and necessary administrative intervention methods should be used so that enterprises put technological progress in an important place. Adjust raw materials and energy prices so that in the process of expanding reproduction enterprises think of ways and means in terms of adopting new technology. All enterprises should strengthen technological development forces, or establish their own healthy development agency, or actively cooperate with scientific research units and institutions of higher learning and seek technological backup. In terms of enterprise adoption of new technology, develop new products which truly are of high quality and favorable prices and provide preferential reduced or remitted taxes so that enterprises stand to gain. Implement a punitive policy for low grade goods and backward industrial processing, impose taxes on backward goods and backward industrial processing to encourage enterprises to eliminate backward industrial processing and goods as soon as possible. Adjust the enterprise investment mix, establish an investment mechanism favorable to technological progress, improve the current situation of short technology development funds, consider increasing the equipment depreciation rate, increasing the enterprise reserve, priority loans by banks to enterprises for developing new technology and expanding the volume, lowering interest rates, and lengthening the repayment period.

Second, intensify reform of the science and technology system so that science and technology department operational mechanisms, organizational structures and personnel management systems are truly oriented towards economic construction. In terms of reforming science and technology operational mechanisms, insist on reform of the appropriation system, thoroughly change the situation of reliance of science and technology development scientific research units on the "supply system" and getting by on government "handouts" to make

scientific research departments go to enterprises to find topics and set up projects, scientific research expenses should come from enterprises, science and technology results should be used in enterprises, establish a development mechanism of science and technology coexistence and co-prosperity with enterprises. At the same time, vigorously manage the technology market, strengthen establishment of technological product management and service agencies so that large groups of results can flow through market channels to applications departments. In changing organizational structures, encourage science and technology units to coordinate closely with enterprises, establish joint scientific research and production, broadly develop technological cooperation; some may enter large and medium sized enterprises, some may become industrial technological development centers, some may become enterprise technology development offices, and some may absorb some medium and small scale enterprises and form a scientific research forerunner enterprise centered on a scientific research unit, thoroughly changing the situation of scientific research departments being outside of enterprises. In terms of personnel management systems, we advocate science and technology personnel mobility, concurrent posts, and after-hours labor, permitting science and technology personnel to resign and take unpaid leaves to go to medium and small scale enterprises and town and township enterprises which are short of talent to be leaders, accept contracts and hire managers so that some science and technology personnel can be free of scientific research departments which have excess talent to go to enterprises, change from scientists to plant heads and managers and become major Chinese-style entrepreneurs and businessmen.

Third, government should intensify macro control and direction. Science and technology, economic, financial, taxation, pricing, industrial and commercial, and banking departments should be closely coordinated, formulate corresponding effective and comprehensive policies, and create an excellent environment for coordination of science and technology with production. The many problems which still exist must be resolved through reform of the political system

#### **Strengthen Coordination Points**

40080029b Beijing KEJI RIBAO in Chinese  
5 Oct 87 p 3

[Article by Hu Lezhen [5170 2867 4176]: "Strengthen the 'Coordination Points' Between Science and Technology and Production"]

[Text] To promote the close coordination of scientific research and production, it is necessary to strengthen the "coordination points" between them.

What are the "coordination points" between scientific research and production? We feel that since the coordination of scientific research and production is essentially coordination of the "processes" of supply and demand of

technological results or the interconnections of the research and development and production and use, the "coordination points" are the series of intermediate links which connect scientific research and production.

Where are the "coordination points" between scientific research and production? Using development of a new product as an example, new product development is based on market demand, using existing scientific and technological knowledge as a base, the new product developed goes through testing, production and sale to customers; the interrelationships are as illustrated in Figure 1.[not reproduced] From Figure 1 it can be seen that there are the following "coordination points" between scientific research and production:

The first "coordination point" is the coordination between technological development and market demand and this is the most important "coordination point". The coordination between technological development and market demand includes the following links: before development, it is primarily market survey and market forecasting, rational selection of the object of development, and clarifying the customer's specific demands of the new product; in the development process, for certain large-scale products and special products, on-site survey, intermediate trials and on-site operational trials should be carried out with users; after the results go into production and are released to the market, customer service should also be initiated, information on product use and the demands of customer opinion should be tracked and collected to further perfect and improve accuracy in the next stage.

The second "coordination point" is coordination of technological development and on-site production conditions to try to unify the technological advanced nature and economic soundness and attempt to shorten the period from technological development to production of the results and their release to the market. It includes the following: Carrying out the necessary technological reform of existing production facilities in line with the technological demands of the new product. New product design (on the basis of experimental research) should pay attention to the natures of industrial processing and the economy, using existing equipment, dies and other industrial equipment to achieve the technological demands of putting the new product into production (including quality and production rate). Necessary revisions should be made in blueprints of products from abroad on the basis of the production technology conditions of the enterprise. Products with especially large work pieces and complex manufacturing processes must use on-site production conditions to carry out industrial processing tests. Large batch production products should undergo small batch trials.

The third "coordination point" is the linkage between technological development and scientific research. It includes the following two aspects: one is that the agencies and personnel engaged in technological development should be good at absorbing and applying new

scientific knowledge so that the technological development work will be enriched with creative spirit and so that the technological results which achieve a higher level; the other aspect is that agencies and personnel engaged in basic research and applied research should stress common problems which are reflected in production and emphasize clarifying basic laws theoretically to provide direction for selection of technological development proposals.

The status of "coordination points" is very important. In a certain sense, promoting coordination of scientific research and production is in essence resolving the problem of "coordination points". The direct cause of the "dislocation of scientific research and production" is that some obstacles have appeared in certain links in the three "coordination points" above. However, resolving the problems between scientific research and production involves a much broader area. This is a very enormous and complex task. Figure 2 [not reproduced] is a structural drawing of "scientific research and production coordination points". The central part of the drawing is "technological development", "application demands", "on-site production conditions", "scientific research" and the three "coordination points" between them. The four fan-shaped areas are the social environment of economic and scientific and technological development. We feel that to coordinate scientific research and production closely, the three "coordination points" must be secure and reliable. For the three "coordination points" to be secure and reliable it is necessary to create an excellent social environment which is beneficial to economic and scientific and technological development. Thus we propose:

1. Enterprises and research institutes should thoroughly implement the directions of "support" and "orientation" in the guiding ideology of their management. This is the first precondition for coordination of scientific research and production. "Support" plays the main guiding role. The current problem is exactly that those large and medium scale enterprises which have an important influence on the national economy and the people's livelihood do not pay enough attention to technological progress.
2. Strengthen the intermediary links of transferring technological results to production, including information networks, technological market agencies such intermediary organizations as related technological consulting, whole technological sets and engineering contracts. Only by establishing healthy technological commodity circulation system, can the promotion and transfer of technological results be accelerated. Of course establishment of a science and technology legal system should also be intensified to guarantee the legal benefits of relevant areas and scientific and technological personnel.
3. The composition of the industrial system and the make-up of the research and development system should be readjusted and reorganized. The existing industrial

and research and development systems which have such defects as "separation of vertical and horizontal" and "dual track operations" in their composition, and lack adaptability to the demands of developing a commodity economy, must be gradually readjusted and reorganized. The key point of readjusting and reorganizing is to advance the integration of scientific research and production, so that a sharing interdependent relationship is formed between enterprises and research institutes.

4. Continue in-depth reform of the economic system, readjust such policies as pricing policy, taxation policy, investment credit policy and consumption funds allocation policy. The primary goal is to invigorate large and medium scale enterprises and invigorate research institutes; guide enterprises and research institutes to overcome their tendency toward short-term behavior; and through spurring enterprise technology progress to improve the rate of development and economic benefits of the entire national economy.

8226

#### **'Oil Field' Satellite Communications Network Operational**

40080038a Beijing KEJI RIBAO [Science & Technology Daily] in Chinese 28 Nov 87 p 1

[Text] On 27 November 87, the PRC's largest dedicated satellite communications network—the "Oil [Field]" Network, located in Gu'an County, Hebei—officially became operational. This network, set up by the Ministry of Petroleum Industry, is composed of 15 satellite ground stations and five microwave stations. It joins several scattered and originally independently operating oil-field communications networks—from Daqing oil field in the north, to the Zhanjiang in the South, the Karamay and Korla [1655 1422 0519] in the West, and the Shengli oil field in the East—into a modern digital-communications system. The system can provide secure telephone and telephone-conference services for organization and direction of petroleum production, intra-system automatic telephone dialing, high low-speed facsimile transmission, teletype service, color still-image transmission, as well as microprocessor data transmission, etc. Begun in March 1985 with equipment completely provided by Canada's Siba [2448 1572] company, this network is capable of providing security for Chinese-manufactured devices and installations, and was developed under the cooperative effort of specialists and technical personnel from the Ministry of Posts and Telecommunications, the Ministry of Electronics Industry, the Ministry of Astronautics Industry, and the Office of the PLA General Staff. Within barely a year's time concluding in November 1987, the equipment installation, network-entry testing, inter-station testing, and combined testing of the entire network were completed.

[Editorial note: Related articles in two other newspapers supply the following additional data: The straight-line length of the entire network of 20 stations is given as

"18,600 kilometers" [Beijing GUANGMING RIBAO in Chinese 28 Nov 87 p 1]. The complete list of oil field ground stations is given as Gu'an, Daqing, Karamay, Liao He, Korla, Erlian, Qinghai, Shengli, Changqing, Jiangnan, Yumen, Zhanjiang, Puyang, Shenzhen, and Nanyang; the five "digital" microwave stations are identified as Beijing, Zhuozhou [3214 1558], and "three others"; the central ground station is identified as Gu'an; and the satellite, whose services are leased, is identified as "Intelsat 5," which was deployed [5 Mar 82] over the Indian Ocean, and which began "network-entry verification testing" in September 1985 [Beijing RENMIN RIBAO in Chinese 28 Nov 87 p 1]]

07310

#### **Plateau Medical, Scientific Research Forging Ahead**

40081038a Beijing GUANGMING RIBAO in Chinese 3 Nov 87 p 2

[Article: "From Scattered Spontaneous Work To Integrated Focused Research; China's Plateau Medical and Scientific Research Forging Ahead"]

[Text] It was learned from the meeting held recently in Xining jointly by the National Plateau Medical and Scientific Research Work Cooperation Society and the China Medical Society's Plateau Medical Association that since the Third Plenary Session of the 11th Party Central Committee, China's plateau medical and scientific research work is forging ahead and has now achieved encouraging results.

China is one of the world's countries with a broad expanse of plateaus and mountainous areas and historically it was also the Chinese who recorded high altitude illnesses first and Chinese who settled and developed the plateaus first. However, in old China, plateau medical research was almost non-existent. Since the 50s, plateau medical and scientific research has gone through the stages of initial enlightenment, increasing knowledge and in-depth research and has now gone from scattered spontaneous work to integrated and concentrated research ranging from measuring the physiological constants of plateau life and epidemiological surveys to the effects of low oxygen environment on body tissue, organs and cell structure and biological, biochemical, pathological, and genetic research. For example, the Qinghai public health department organized province-wide medical treatment units and in 1980, 1984, and 1987 carried out three comprehensive plateau medical investigations and conducted very in-depth research on the biological characteristics of plateau inhabitants and nomads, each investigation was deeper than the last. Currently, the mechanism of plateau pulmonary artery hypertension and increase in hemoglobin is being further explored and the different imports of moderate effect and excessive effect have been discriminated; the location of plateau breathing obstruction during sleep in outbreaks of plateau disease has also been researched; the adaptation

characteristics of local plateau fauna have been compared; and they have penetrated to the areas of genetics and ultrastructure changes. At the same time, nationwide many local and PLA treatment, scientific research and teaching units have carried out plateau medicine on-site research and experimental research and have done a great deal of work in such areas as plateau biology, low oxygen pulmonary artery hypertension, and treatment and research of acute and chronic plateau illnesses. The Shanghai Institute of Biology of the Chinese Academy of Sciences has worked with the scientific survey ascent of Mt. Qomolangma and obtained biological materials on the human body characteristics high above sea level. Qinghai, Xinjiang, Xizang, Beijing and Shanghai have established such plateau medicine research agencies as the Plateau Medical and Scientific Research Institute. At the same time the scientific research corps has become stronger and grown constantly. Not only are old specialists and old professors participating in this research, but a group of young cadres with a good theoretical foundation and an abundance of practical experience are too. The accumulated information, experience and scientific research results in plateau medicine are rapidly exchanged at home and abroad. In the past 10 years, the PLA has systematically convened five scholarly symposia on plateau medicine: at Xining they convened two national "Plateau Medicine Symposium", published such monographs as "Plateau Illness" and "Practical Plateau Medicine", created the journal "China Plateau Medicine" and visits from, and specialized cooperative research with, scholars from various countries is also flourishing.

8226

#### **Guangdong to Relax Restrictions on Scientists, Technicians**

40080041b Hong Kong ZHONGGUO XINWEN SHE in Chinese 0637 GMT 8 Dec 87

[Text] Guangzhou, 8 December (ZHONGGUO XINWEN SHE)—Beginning next year, Guangdong Province will relax restrictions imposed on scientific and technical personnel and encourage them to engage in various undertakings in coastal, mountain, and rural areas as well as in towns and cities, so that they can fully exploit their abilities.

Guangdong Province will soon promulgate the "Methods for Implementing the Relaxed Policy on Scientific and Technical Personnel." According to this document, if scientific and technical personnel want to participate in various undertakings in cities, towns, and rural areas through transfer, resignation, or taking leave without pay (those in the government organizations should not ask for no-pay leave), their units should approve their requests.

The "Methods" also includes the following: Scientific and technical personnel can participate in various undertakings as organized groups or as individuals without

being restrained by their areas and departments; those who have professional titles can preserve their original residence registrations and the status of cadres and can apply for professional or technical posts according to relevant regulations; if the scientific and technical personnel with professional or technical titles do not want to extend their service in those undertakings when their terms expire, they can be assigned to other posts by the department in charge of the units that employ them; they can also enjoy labor insurance and other benefits stipulated by the state and can apply for other professional or technical posts.

Those who have been invited to work in small minority nationality areas and poor areas can receive higher pay than their original wages, and they can retain all their personal income rather than handing it over to their original units.

The "Methods" will be put into effect as of 1 January 1988.

9919/12913

#### **Shenyang Constructing a "Silicon Valley"**

40080049 Hong Kong ZHONGGUO XINWEN SHE in Chinese 1027 GMT 18 Dec 87

[Report by Jin Guolin (6855 2654 2651): "Shenyang Building a 'Silicon Valley'"]

[Excerpts] Shenyang, 18 Dec (ZHONGGUO XINWEN SHE)—Shenyang, the famous industrial city situated in northeast China, has started building its own "silicon valley"—Shenyang Nanhu Scientific and Technological District.

Shenyang Nanhu Scientific and Technological District is located in the southeastern part of Shenyang City and has an area of about 15 square km. It will focus on developing new and high-tech projects such as biological engineering technology, automation technology, new-material technology, information technology, and laser technology. Experts believe this Scientific and Technological District has favorable conditions similar to that of the Beijing Zhongguan Cun Electronic City. The district will have eventually 10 more colleges and universities and 20 more scientific research institutions. In addition, there will also be 50 more small factories that can apply new technologies.

The western part of the Nanhu Scientific and Technological District has a concentration of universities, colleges, and scientific research institutions, and will become a scientific research and teaching area. A number of small factories will be located at the eastern part and will become a developing industrial area. A "Science Park" and a "Science and Technology Museum" are also planned to be built there.



Officials believe that Shenyang is a vital industrial base. However, due to the fact that traditional industries have occupied a dominant position at Shenyang, the situation of high input, low output, large consumption, and small benefit which resulted is inconsistent with its industrial foundation and economic strength. At present, the departments concerned are formulating favorable policies regarding investment, credits, and personnel for this district. It is also planning to use foreign funds to import foreign expertise.

/06662

### **Superconductor Research Now Said at Advanced World Levels**

40080038b Beijing GUANGMING RIBAO in Chinese  
4 Dec 87 p 1

[Article by reporters Hu Youquan and Zheng Guoqing:  
"China Again Makes Significant Progress in Superconductor Research"]

[Text] China again makes significant progress in superconductor research. The Graduate Student Institute of the China University of Science and Technology recently developed a practical device for high-critical-temperature oxide superconducting magnetic shielding and [also developed] a chemical-deposition superconducting coating. These two advances have brought China's superconductor research into a continual position of world leadership.

A research group led by Professor Chai Zhang [2693 3864] of the Graduate Student Institute of the China University of Science and Technology and the Yang Peiran research group of the Physics Institute of the Chinese Academy of Sciences closely cooperated in the initial development of a practical magnetic-shielding device operating in a liquid-nitrogen temperature environment and capable of completely shielding a 150-Gauss magnetic field. The test results indicate that this type of magnetic-shielding device is useful for obtaining very good magnetic shielding, thereby bringing China's research into high-critical-temperature oxide superconductors to a practical level.

Li Biqin, Chai Zhang, and others utilized chemical-deposition techniques to manufacture a barium-yttrium-copper-oxide superconducting coating with a zero-current barrier at 82K and a coating thickness of only 5-6 microns. Using chemical-deposition techniques to prepare a superconducting coating reaching the liquid-nitrogen temperature range, they employed the highest standard of conditions. This achievement was also accomplished with the cooperation of relevant personnel of the Physics Institute of the Chinese Academy of Sciences.

07310

### **Song Jian on Training, Respecting S&T Personnel** 40080041a Beijing XINHUA Domestic Service in Chinese 1217 GMT 15 Dec 87

[By reporter Zuo Peirong]

[Text] Beijing, 15 December (XINHUA)—Song Jian, state councillor and minister in charge of the State Science and Technology Commission, said recently that the state is formulating a policy of training scientific, technological, and management personnel from among workers and peasants. In respecting and caring for talented people, we should not only respect and care for those who have received specialized education, but also the personnel emerging from among the workers and peasants.

The training and use of talented people should also be done in the spirit of reform. The point of departure and fundamental criterion for all our work is whether it is conducive to the development of the productive forces. We must base our cadre policy on this principle and bring into play their creativity. Practice over the past few years shows that the problem of personnel has been solved rather well and the economy has developed rapidly wherever local authorities, under the principles and policies of the state, have dared to create, to shoulder responsibility, and to open up a new situation. Otherwise, the work will be lifeless and economic development slow.

He said: We have eliminated the foolish, backward social attitude of despising knowledge and talent that prevailed for a time. Recruiting talented people has become a regular practice in recent years and in some areas talent has become the target of competition. If the various localities, the outlying provinces and economically backward areas in particular, can come up with some new measures to attract talented people, it will be their greatest contributions to their respective economies.

He pointed out: Proceeding from the fundamental objective of developing the productive forces, we must, while attracting external talent, pay attention to bringing up personnel from among workers and peasants. This is especially important insofar as developing the local economies are concerned. Indigenous personnel are closely bound up with local people and communities; they are most qualified to take the lead in developing the local productive forces. At present, there are more than 100 million junior and senior middle school graduates and demobilized soldiers in urban and rural areas across the country. They are most willing to implement reforms and to contribute. With the guidance of a correct policy, these people will become a backbone force in developing the productive forces. Potential skilled personnel are all around us. So long as we dare to reform and to adopt measures to bring up thousands upon thousands of personnel among the educated young workers, advanced productive forces of a new type will spring up vigorously all over the country.

2468/12913



**Pattern Laboratory Offers Consultancy Services**  
40100003a Beijing XINHUA in English  
1438 GMT 22 Dec 87

[Text] Beijing, 22 December (XINHUA)—The pattern recognition laboratory of the Chinese Academy of Sciences will be the first in China to offer consultancy services to both domestic and foreign researchers.

The lab, finished 19 December, will provide services to organized domestic researchers soon, according to a spokesman for the lab.

It will also invite foreign researchers to visit and conduct research, he added.

Able to process various input and output computer signals, the lab will focus on pattern recognition, human intelligence, and computer images and techniques.

At present, 16 Chinese research workers are working in the lab, which is capable of accommodating 40 to 50 visiting researchers at a time.

The lab, which took 3 years to build, involved a total investment of 11.5 million yuan.

3292/12913

**State-Run Units Report Talent Drain**  
40100003b Beijing CHINA DAILY in English  
24 Dec 87 p 3

[By staff reporter Cheng Hong]

[Text] More and more scientific personnel have left State-run units and enterprises for collectively-owned and individual units. Also more such people have left areas populated by minorities, and remote and poor areas.

These trends were shown in a survey recently conducted in 28 provinces and regions. The survey covered more than 310,000 scientific personnel from national research and development organizations, higher education institutions and big and medium-sized enterprises.

The survey showed that during three-and-a-half years from 1 January 1984 to 1 June this year, there were more than 220,000 scientific personnel coming in to the three systems of units, but 314,000 people moving out. Among them, 44,000 personnel flowed in and 61,000 people flowed out of the system of research and development organizations; in higher learning institutions, 41,500 in and 37,100 out; for big and medium-sized enterprises, more than 140,000 in and over 200,000 out.

The survey also showed that a lot of scientific personnel have moved to jobs in administrative department in all levels of government, which goes against the wishes of the State.

However, in coastal areas where there is more economic reform, more talented personnel have moved to collectively-owned and individual enterprises, showing the effects of the new policies.

In the past few years, many scientific personnel have moved away from poor areas. In the past three-and-a-half years, 6,844 scientific personnel left the poor areas, while the number of people coming to these areas was 2,839.

An official from the State Nationalities Affairs Commission told CHINA DAILY that scientific personnel don't choose to go to poor areas mostly because of the poor working conditions.

As for the talented personnel in areas inhabited by minorities, most of them are thinking of going back to their home towns because they are not used to the climate or they are worrying about the future of their children," he said.

"Owing to the lack of money, the minority areas cannot offer a good environment to the personnel to give full play to their ability and intelligence. Despite that, there are some preferential arrangements in Xinjiang and Gansu," he said.

The official also said the policy of promoting the free and reasonable flow of talented personnel is not perfect. Even where there is such a policy, it is not always carried out properly.

The latest national talented personnel exchange meeting announced in Hebei's Shijiazhuang city on Tuesday that more than 360,000 research fellows and other technical personnel in China's big cities have been engaged by rural enterprises to help with innovation and training.

This is a major breakthrough in China's reform of the existing scientific and technological administrative system.

For a long time, many technicians working in overstaffed research institutions, universities and larger State enterprises found it impossible to fully display their talents and professional skills. Yet, at the same time, small and medium-sized rural factories were showing poor economic results because of the shortage of competent technicians.

To alleviate the acute shortage of technical personnel, the provinces of Hebei, Shandong, Sichuan and Liaoning allowed local technicians to transfer to poor rural areas.

0420/12913

**Micro-Electronic Technology Application Still Small**

40100002a Beijing XINHUA in English  
1306 GMT 14 Dec 87

[Text] Beijing, 14 December (XINHUA)—Chinese scientists forecast that before the year 2000, China will mainly develop such consumer electronic goods as tv's and tape recorders, and concentrate its investment efforts on micro-electronic goods used in industry and the information and service sectors.

The prediction was made by more than 100 scientists and researchers after they investigated and analysed 956 micro-electronics-related units in China's 17 provinces and municipalities.

The project, labeled "Forecast of China's Micro-Electronics Applications," is aimed at providing a scientific foundation on which the country can formulate appropriate policies to develop information technology and micro-electronics.

In the past two and a half years, researchers studied the domestic market for micro-electronic technology and analysed the laws governing the application of micro-electronic technology in China. They obtained reams of data reflecting the present situation with respect to China's micro-electronic technology and its applications.

By the end of 1986, China had about 200,000 computers of all kinds, and developed a number of important breakthroughs, such as 64K dynamic memory circuits and the large-scale computer (100 million calculations per second).

However, researchers pointed out that though micro-electronic technology is being rapidly introduced into the country's service and information sectors, its application is still on a small scale as a whole. The production of integrated circuits and computers is still at a low level, with few new varieties developed.

They suggested that for micro-electronic technology and its applications to thrive in China, it needs to be included in the overall national economic development strategy.

They added that the country should first focus its efforts on developing micro-electronic technology for large-scale production and new electronic products. At the same time, the country should also pool funds and technology for establishing a basis on which to learn from and eventually compete with the international marketplace.

They said that at present, priority in applying micro-electronic technology should be given to the most efficient enterprises in the fields of petroleum production, power development, metallurgy and chemicals.

They proposed that the country should also set up electronic enterprise groups aimed at the world market.

2052/12913

**Vice Minister on Electronics Industry Progress**

40100002b Beijing XINHUA in English  
1054 GMT 15 Dec 87

[Text] Beijing, 15 December (XINHUA)—The output value of China's electronics industry this year will surpass 40 billion yuan (about 10.8 billion U.S. dollars), an increase of more than 30 percent over 1986.

Speaking at a national working conference here today, Zhang Xuedong, vice-minister of the electronics industry, said China's economic reform and the policy of opening to the outside world have helped the electronics industry grow at an annual rate of 20.3 percent in the past nine years, double the average increase in the country's overall industrial growth rate. This year China expects to produce 16.8 million television sets, a jump of 22.5 percent over 1986. Of that total, an all-time high of six million are color sets.

Year-end production figures will also include 15 million tape recorders, 59,000 microcomputers and 78 million integrated circuits, increases ranging from 15.5 to 70 percent over last year.

Electronic technology and equipment from China have also penetrated the international market. High-quality TV sets, cassette recorders and electronic components have been exported to developed countries such as the United States, Japan and Britain. In 1987, exports of electronic products are expected to reach 500 million U.S. dollars, an increase of 43 percent over 1986.

Progress has also been made in the construction of five major projects to produce powerful integrated circuits, color-television tubes and glass, program-controlled switchboards, video recorders and computers.

Scientific research has helped the country's electronics industry produce a number of new products, Vice-Minister Zhang added. In this year alone, about 66 scientific innovations have won state prizes for excellence.

The vice-minister predicted China's electronics industry will keep growing at a rate of 15 to 20 percent next year.

2252/12913

**Xiamen To Set Up More Export-Oriented High-Tech Firms**

11081427 Beijing XINHUA in English  
0804 GMT 8 Jan 88

[Text] Beijing, January 8 (XINHUA)—cooperation in science and technology between China's electronics industry ministry and Xiamen in Fujian Province is helping the city set up more export-oriented electronics firms.

According to today's "Guangming Daily," the cooperative projects started last year, and are building the city into a hi-tech development zone and export base.

Xiamen decided to improve the city's electronics industry, and after consultation with the ministry, a long-term cooperative agreement on electronics information and technology, and 14 other key agreements were signed.

To lure more scientists and technicians to jobs in the city, the Xiamen government worked out a series of preferential policies. To date, 13 institutes affiliated with the ministry have sent personnel to Xiamen to work on developing new products.

The manufacture of hard computer discs, a key project during the state's seventh five-year plan (1986-90), will be jointly handled by one ministry institute and the city, and is expected to start operation this year.

**Second S&T White Paper To Be Available Soon**

11121202 Beijing XINHUA in English  
1059 GMT 12 Jan 88

[Text] Beijing, January 12 (XINHUA)—China's No. 2 white paper on policies concerning science and technology, compiled by the state science and technology commission, has been published and will be distributed soon both at home and abroad.

The paper covers the laws and regulations on science and technology promulgated by the Chinese government in 1986 and 1987, progress made in the reform of the scientific and technological management system, and scientific legislation and research.

It also introduces China's hi-tech research, the "spark" program aimed at spreading relevant technology to rural areas, and scientific research and technology development conducted by the Chinese academy of sciences and institutions of higher learning, as well as medical sciences and agro-sciences.

Also included in the paper are speeches on these subjects made by chinoblrtly and government leaders over the past two years, the law on technical contracts and regulations on rewards for scientific achievements.

China published the No. 1 White Paper on Science and Technology in 1986. It covered major policies concerning science and technology worked out since 1978, and the basic principles and strategy for the development of China's science and technology.

### Major Contributions of Prominent S&T Personnel Reviewed

40080017 Beijing BEIJING RIBAO in Chinese  
3 Aug 87 p 4

[Article: "The Major Contributions of 14 Middle-Aged S&T Specialists"]

[Text] Fourteen middle-aged S&T workers invited for a vacation at Beidaihe by the CPC Central Committee ended their vacations on 2 August 1987 and have returned to their jobs. This reporter visited each of these S&T experts during their vacation and will introduce their major contributions to the four modernizations drive and the development of S&T in China.

[1] Hu Renyu [5170 0088 1342]—Researcher in a certain research academy in the Ministry of Nuclear Industry and an expert in experimental nuclear physics. Since graduating from Qinghua University in 1952, he has been involved in research and experimentation on nuclear technologies in China. He participated in preparations for construction and leadership of several nuclear physics laboratories. He has actively applied new technologies and new equipment, developed new measurement methods and continually perfected testing technologies for research and experimentation on nuclear technologies and has made significant contributions to the development of nuclear technology in China. He was one of the main authors of "Research on Aggregate Blast Wave Artificial Thermonuclear Reactions" which received a first place state natural science award. He has made substantial achievements in the nuclear technology experiments he directed which are indicative of his rather high scholarly levels and organizational leadership abilities.

[2] Tang Zhaoyou [3282 6856 3731]—Professor at Zhongshan Hospital in the Shanghai College of Medicine, specialist in research on cancer of the liver. He has studied cancer of the liver for many years and his research on minor liver cancer holds a leading position internationally. The survival rate five years after surgery for minor cancer of the liver is 70 percent and he received a first place state award for scientific and technical progress in 1985 and a gold plaque award from the United States in 1979. He is at the center of projects for attacks on key tumor issues during China's Seventh 5-Year Plan. He has served twice as chairman of the International Conference on Tumors of the Liver and Gall Bladder. He was the chief editor of the first Chinese book on "Primary Liver Cancer" and the first international book on "Subclinical Liver Cancer (English Edition)." He is an outstanding medical scientist who is continually forging ahead as well as a doctor who is constantly making technical improvements and wholeheartedly serving the people. Everyone's evaluation of him is that his work has caused people to see that the "king of the cancers" may be curable.

[3] Wang Demin [3769 1795 3046]—Chief Engineer in the Daqing Oil Field Management Bureau, Ministry of Petroleum Industry and an expert on oil extraction technologies. He has been involved continuously with oil extraction technologies and technical management since graduating from Beijing Petroleum College in 1960. Over the past 27 years, he has independently taken the lead in more than 30 successful scientific research projects and has earned one second place state creativity and invention award and three national science conference awards. He is a leader in techniques for extracting oil from thin oil-bearing strata and low permeability oil-bearing strata and has provided technical measures for extracting oil from these strata. He was a main participant in scientific research achievements concerning "Water Injection Exploitation Technologies for Long-Term High and Stable Output at Daqing Oil Field." The overall project attained advanced international levels and generated enormous economic benefits, and it received a special state award for scientific and technical progress in 1985. He has been named twice as an example for science and technology at Daqing and also has been named an advanced S&T worker by Heilongjiang Province and the National Science Conference.

[4] Min Guirong [7036 2710 2837]—A researcher in a certain research academy in the Ministry of Astronautics Industry, and an expert on satellite design. He led the thermal designing and thermal testing of "Dongfanghong No. 1," China's first satellite and was the first to propose a far-infrared simulated heating method for average heat flow in partial satellite orbits and designed a satellite far-infrared heating container which answered key questions regarding temperature control design. He also led work to design recoverable satellites and coordinated management. Two satellite projects in which he was leader or main participant received special state awards for scientific and technical progress in 1985. He had made prominent contributions to the development of space technologies in China and was named a model worker in the Ministry of Astronautics Industry in 1980.

[5] Gu Songfen [7357 6139 5358]—Advanced Researcher in the S&T Commission of the Ministry of Aviation Industry and an expert on aerodynamic aircraft design. During the 1950's he participated in organizing China's first aircraft design office and was responsible for aerodynamic design of the Jianjiao-I aircraft, the first step from imitation to independent design in China's aviation industry. During the 1960's, he participated in leadership of the independent design work for the Jian-8 aircraft, which can fly 2.2 times faster than the speed of sound. In 1981, he became chief designer for the Jian-8-II aircraft and made prominent contributions to the design of modern fighter planes. He received an achievement award from the Liaoning Provincial Science Council in 1978. He was named a model worker in the Ministry of Aviation Industry in 1984.

[6] Ni Weidou [0242 4850 2435]—Professor at Qinghua University and a specialist in thermal energy engineering. He has made creative achievements in establishing mathematical models of thermodynamic systems. He used modern control theory to analyze the dynamics of thermodynamic systems and has been the leading innovator in China and among the front ranks internationally in this field. In the area of teaching, the results of his teaching have been good and he has actively engaged in ideological work for students. He has trained or now is training eight masters degree students and seven doctoral students, and he is a good teacher who is loved by his students.

[7] Ye Disheng [0673 6611 3932]—Manager of the Tianjin Municipality Economic and Technological Development Zone and an expert in semiconductor manufacturing. He has successfully developed more than 50 types of semiconductors which account for more than 50 percent of sales of quite a few products and have provided major economic returns. He is known as a Jiang Zhuying [5592 4591 5391] and Luo Jianfu [5012 0256 1133] type superior S&T cadre and a man of action who dares to be creative. He was named a "superior S&T cadre" by the Ministry of Electronics Industry in 1983 and a top-grade model worker and city-wide example by Tianjin Municipality. He was an overseas Chinese who is determined to contribute to the four modernizations drive in his motherland and has a lofty spirit of patriotism.

[8] Wu Zhizhong [1566 5268 0022]—Advanced Engineer in measurement and control technologies at a certain base area in the National Defense Science, Technology and Industry Commission and an expert in missile measurement and control. He participated in the overall work on measurement and control systems in 18 satellite launchings and some missile flight tests in China. In 1968, he assumed responsibility for designing an "information flow chart" for a measurement network for China's first satellite and filled in a blank page in the history of space measurement and control in China. The "near-earth satellite measurement and control system flow chart" he designed played a role in satellite recovery in 1975. In 1984, he compiled four technical articles that played an important role in satellite fixed-point synchronization and was awarded a second-place ministerial S&T achievement award. The "synchronous communications satellite measurement and control strategy" in which he was the main designer received a second place state S&T progress award, and he earned a first-place award for individual merit.

[9] Wang Xiaomo [3769 1420 6206]—Advanced Engineer in a certain research institute in the Ministry of Electronics Industry and an expert in radar design. He has studied radars for many years and has participated in all types of radar research, design and technology work. He was appointed deputy chief designer of China's first three-coordinate radar in 1963. He has served as chief designer for a type of three-coordinate radar since 1972.

A radar developed under his leadership performs well, has a high degree of automated procedures and is definitely at rather advanced levels. It has filled in a blank in China's three-coordinate radar. He was named an advanced worker in the national defense industry system in 1980, an advanced S&T worker in the Ministry of Electronics Industry in 1982 and was named by the state as an expert who has made prominent contributions in 1984.

[10] Li Chengdong [2621 2052 2767]—Chief Engineer in the Kailuan Mining Bureau, Ministry of Coal Industry and an expert in coal extraction technologies. He has worked with mines for a long period and completed "coal extraction from the three unders" (under railroads, under structures, and under water), 14-bed deep development, pillar-less extraction and other major scientific innovations and has made a major contribution to expanding resource extraction. He often works in the mines with the workers and has even risked his own life to carry out on-site prospecting. He was successful in water control at the Kailuan mine and was deputy commander of water control for re-mining, for which he received a second-place award for meritorious service. He was named a "superior specialized technical cadre in the coal system" and received a "May 1st labor award" in 1985.

[11] Li Guilian [2621 2710 5571]—A vegetable specialist in the Guizhou Provincial Academy of Agricultural Sciences. She has been involved in scientific research on vegetables since graduating from the Guizhou College of Agriculture in 1964 and has made vegetable consumption problems of people in cities and in industrial and mining regions her glorious mission. From 1979 to 1984, she resolutely stayed in poor mountainous Luoxun County to gain firsthand experience, studies early vegetables and early watermelons, and helped the local peasants shift from primitive extensive cultivation to plastic film ground cover cultivation and other modern cultivation practices, which have brought prosperity to the more than 5,000 peasant families in the county. She also established demonstration vegetable gardens in some counties and trained a large group of vegetable technology backbone cadres. She is highly respected by the masses and has become known as a "Goddess of Wealth." She has been named an "advanced worker in nationality unity in Guizhou," a "top-grade provincial model worker," a "national March 3rd [Women's Day] red-banner pacesetter" and a "national superior CPC member."

[12] Xu Junlie [6079 0689 3525]—Deputy Chief Engineer in a certain academy of design in the Shipping Industry Corporation, has worked for many years in design and study of various types of submarines. He participated in leadership of certain underwater submarine launch test technologies and made a major contribution to underwater submarine launching of launch vehicles, for which he earned a second-place ministerial level S&T achievement award. He was responsible for



overall technical work during tests of certain underwater submarine launches of simulated projections and received a major military industry scientific research project award from the Shipping Industry Corporation in 1984. In 1986, his comprehensive research design for a particular type of submarine received a special state S&T progress award.

[13] Jiang Chengwei [5592 2110 3555]—Researcher in a certain research institute in the State Machinery Industry Commission and an expert on hybrid explosives. He has been engaged in research on high energy hybrid explosives for many years. The research on 10-159 high energy plastic cohesive explosives in which he was a main participant has achieved widespread application and its performance in some areas has reached or surpassed current internationally-announced levels, for which he received a state invention award in 1985. The research achievements in which he has participated have received three National Science Conference awards and many achievement awards at the ministry and provincial levels and above.

[14] Ma Songde [7456 7313 1795]—Assistant Researcher, Institute of Automation, Chinese Academy of Sciences and a leading developer of advanced technologies in China. He has rather extensive accomplishments in computer imaging and image processing, and he has made pathbreaking achievements in both Chinese and international terms. In 1985, he earned two of the three superior awards given in the Annual Conference of the European Computer Imaging Society as well as an award for the best article and another for the best technology. He earned a doctorate in engineering and a French national doctorate while studying in France. Gratifying progress is being made in research on robot imaging topics which he is directing now.

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**Antibiotics Research Institute Re-named**  
40081039a *Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY]* in Chinese 29 Sep 87 p 2

[Article by Tang Guoxing [3282 0948 2505] and Han Weilin [7281 3555 3829]: "Marching Toward New Technology in Medicine"]

[Text] The Institute of Medical Biotechnology of the Chinese Academy of Medical Sciences is located in a modern building at the southwest corner of Tiantan Park in Beijing.

Its predecessor is the Institute of Antibiotics founded in 1958. It was renamed the "Institute of Medical Biotechnology" in 1986. Shortly after the institute was founded, they solved the technical hurdle in the final step of producing penicillin and began to use all domestic raw materials. It stopped China's dependence on imports.

As a result of the reforms implemented since the Third Plenum of the 11th Congress of the Chinese Communist Party, the institute expanded from the screening of simple antibiotics to anti-tumor and anti-virus antibiotics, cardiovascular drugs, anti-inflammatory agents, enzyme inhibitors and biological response adjusting agents. It grew from a single natural microorganism screening process to a variety of processes including semi-synthesis, total synthesis, biological re-construction and re-arrangement of the "silent gene." The screening has been developed from the overall level to the cell level and the molecular level. In the past 9 years, they have received 29 technical awards from the central government and ministries. In addition, they also established the first computer based antibiotics database ADMS in China.

Biotechnology is a powerful force in modern technology reform. The institute has been watching the trend and decisively changed its strategy to pursue medical biotechnology. Since 1980, based on their fermentation technology they have initiated research in genetic engineering, cell engineering, enzyme engineering, and biological reactors and transducers. At the present time, they are the first group in China to have isolated DNA particles. Monoclonal antibodies against cancer of the liver and sinus have been found. Significant progress has also been made in enzyme engineering and in biological reactors and transducers.

It should be pointed out that the anti-leukemia "biological missile" developed by the institute in August 1986 brings new hope to mankind in curing cancer. Once this anti-cancer drug is developed, the treatment of tumors will be drastically improved.

The institute has a team of specialists in biotechnology, as well as in closely related fields such as microbiology, biochemistry, organic chemistry, pharmacology, tumors, toxicology, immunology and medical technical information. There are more than 250 technical staff members, including 45 senior research staff. We hope that they enter the leading edge in research and development.

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**First Research Institute of Cell Physiology Founded**  
40081039b *Beijing GUANGMING RIBAO* in Chinese 3 Nov 87 p 1

[Article by reporter Ye Gui [0673 6540] and special correspondent Xu Youzhi [1776 2589 2535]: "Four Major Accomplishments in Biomedical Engineering by Yu Bi [0151 8696]: First Cell Physiology Laboratory Founded and New Progress in Cholic Acid Ion Selective Microelectrode"]

[Excerpts] In late October, the reporters visited the first cell physiology laboratory in China at Zhejiang University. The person in charge, Yu Bi, is a middle-aged

scientist who is the inventor of the first micro-detector for intracellular organic ion activity—the dual channel acetylcholine selective microelectrode. Yu excitedly told the reporters, "Look, the lab was finished in 3 months. It has only been 6 months since I returned to China and the lab is in good shape. We have already made some preliminary progress in the development of a cholic ion selective microelectrode. This is a surprising speed even to myself."

Yu, who is 43, was a lecturer at Tongji Medical School in Wuhan. In 1981 he went to the Institute of Physiology of the famous Marx Planck Institute in West Germany to study physiology of the nerve and cell. During his stay, he completed over 10 projects and achieved four major accomplishments. His invention of the "dual channel acetylcholine selective microelectrode" is the first sensor for an organic ion in the world. This is a major step in the development of new biomedical detectors. The director of his institute, the world renowned Dr Lubbers, considered that his work opened an entirely new area for research. Another accomplishment, a "highly stable polarographic surface oxide electrode," was reviewed by Dr Lubbers. Its stability is considered to exceed that of similar products. In early 1986, he had a major breakthrough in the development of a histamine and a 5-hydroxytryptamine selective microelectrode. The world renowned German biologist Wigner said that "It is a leading edge accomplishment in the field."

Yu pointed out to the reporters that such a laboratory is not only the first in China but also rare in the world. Most of the instruments are imported from West Germany. Some of them are hard to find in laboratories abroad. Yu pointed at an instrument and said that "This is the most advanced microelectrode controller. This recorder is also a brand new product capable of recording six signals simultaneously."

Yu told the reporters that he began to be involved in the development of a cholic acid sensitive microelectrode with German experts while the lab was under construction. Some preliminary results have been obtained in the past 6 months.

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### **Shandong Soft Science Research Society Established**

*16080505 Jinan Shandong Provincial Service in  
Mandarin 2300 GMT 7 Jan 88*

[Text] The Shandong soft science research society was established in Jinan on 7 January. Lu Maozeng, deputy secretary of the provincial party committee; Su Yiran, chairman of the provincial Advisory Commission; Lin Ping, vice chairman of the provincial People's Congress Standing Committee; Ma Zhanggui, vice provincial governor; and Ding Fangming, vice chairman of the provincial CPPCC Committee, attended the inaugural meeting.

Softy science is a new science with a collection of various branches of knowledge which mainly provides consulting services for economic, scientific, technological, and social development policymaking.

Over the past years our province has conducted more than 1,300 soft science research projects, such as applying systems engineering to agriculture, studying site selection for the construction of Shijiu Port during the early stage, moving the whole set of drilling machines of Shengli Oilfield, appraising the technological and economic results of the Huang He diversion irrigation project, and investigating and studying natural resources as well as the development and utilization of the four lakes in the southern part of Shandong. Some major research achievements won state or provincial awards.

The founding of this research society will further promote the development of province soft science research.

Liang Buting, secretary of the provincial party committee; Su Yiran, chairman of the provincial Advisory Commission; and (Pan Chengdong), president of Shandong University, are honorary chairmen of the board of directors of the research society and (Ding Xuechao), vice chairman of the provincial Scientific and Technological Commission, is chairman.

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